The Welding Engineer

Reg. U. S. Pat. Office

Founded by L. B. Mackenzie, 1916

JULY, 1929 VOL. 14, NO. 7

$3.00 per year in U. S. 608 S. Dearborn St., Chicago, Ill. $4.00 per year abroad

Economical Plant Operation *demands* Oxwelded Piping

" . . . that an oxy-acetylene welded pipe line is cheaper in initial cost than a screwed one by at least 30 per cent, and that maintenance cost is reduced approximately 80 per cent, is borne out by numerous data from actual installations . . . Many tests have demonstrated that a properly made oxy-acetylene welded joint is as strong as the pipe wall itself . . . higher pressures may be safely carried."

excerpted from April, 1929, issue of "Western Machinery World"

The Best of Everything for Oxwelding and Cutting

LINDE OXYGEN
The Linde Air Products Company

Prest-O-Lite
Dissolved Acetylene
The Prest-O-Lite Company, Inc.

Oxweld
Apparatus and Supplies
Oxweld Acetylene Company

UNION CARBIDE
Union Carbide Sales Company

UNION CARBIDE AND CARBON CORP.
General Offices: 30 E. 42nd St. New York, N. Y.
Units of UCC
Offices in Principal Cities Throughout the Country

64 Linde Plants—45 Prest-O-Lite Plants — 154 Oxygen Warehouse Stocks—138 Acetylene Warehouse Stocks—38 Apparatus Warehouse Stocks 235 Carbide Warehouse Stocks

Published monthly by the Welding Engineer Publishing Co. Entered as second class matter Jan. 20, 1916, at the Post Office at Chicago, Ill., under the Act of March 3, 1879.

Resistance Welding with ELKONITE increased production 50%

This shows ELKONITE electrode wheel. The Elkonite may be seen along the edge of wheel to a ¼" depth. Next to the electrode is shown the horn after the weld.

THE use of electric resistance welding is rapidly increasing not only in the smaller welding plants but also in the large industries where high speed production at low cost must be maintained. This is particularly true of the Automotive Industries where resistance welding has been generally adopted.

One large manufacturer* of automobile horns has increased production over 50% by resistance welding with ELKONITE. The output of each machine averages over 500 per day. Copper electrodes on this seam welding job had to be redressed 3 times every day. The ELKONITE electrodes have increased production materially because they require redressing only once every 2 weeks. And they make a better weld with less shrinkage.

Two of the electrodes are still making good welds after more than a year's operation—conclusive proof of Elkonite superiority!

This is only one of the many applications of resistance welding on which ELKONITE has increased production and reduced costs. Our engineers will be glad to consult with you on your resistance welding problems—without obligation to you—and tell you about the many applications which are now practical due to the exceptionally long life of ELKONITE.

*Name on request

ELKON, Inc. (Elkonite Dept.)

Division of P. R. Mallory & Co., Inc.

3029 East Washington St.

Indianapolis, Ind.

EXCLUSIVE LICENSEES UNDER GENERAL ELECTRIC CO. PATENTS DATED MAY 26, 1925, AND SEPTEMBER 1, 1925. OTHER PATENTS PENDING TO ELKON, INC.

ELKONITE

REG. U.S. PAT. OFF.

21 OUT OF 22 WELDERS VOTED FOR AIRCO-D.B. TORCHES

The following letter was recently received from the Welding Superintendent of a leading manufacturer of oil well equipment.

"After trying five competitive makes of welding torches over a period of three months, it was decided to take a vote among the welders as to which torch they preferred. At that time there were twenty-two welders in our employ and twenty-one voted the Airco-D.B. 8800.

"An order was placed for twenty-six of these torches, completely standardizing our plant. This was on Feb. 28th, 1929, and since standardizing we have ordered fifteen more, making us forty-one. Today we are ordering seven more, making forty-eight.

"Each welder is furnished with his own torch and is responsible for its care."

AIR REDUCTION SALES COMPANY

Manufacturers and distributors of Airco Oxygen, Airco Acetylene, Airco National Carbide
Airco-Davis-Bournonville Welding and Cutting Apparatus and Welding Supplies

Baltimore
Bettendorf, Ia.
Birmingham
Boston
Buffalo
Charlotte, N. C.
Chicago
Cleveland
Dayton
Detroit
Emeryville, Calif.
Jersey City

AIRCO
DAVIS BOURNONVILLE

Los Angeles
Louisville
Milwaukee
Minneapolis
New Orleans
Oklahoma City
Philadelphia
Pittsburgh
Portland, Ore.
Richmond
Seattle
St. Louis
Wheeling

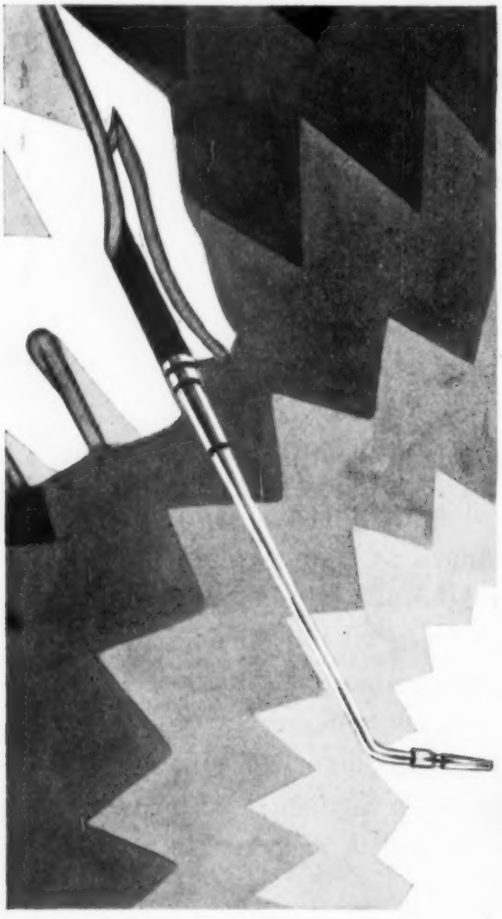
88 Plants — Home Office: 342 Madison Ave., New York City, N. Y. — 115 Warehouses

Better welding with *Chase Chāmet* Bronze*

Oxy-acetylene welding with Chase Chāmet* Bronze is easy, economical and efficient. The weld can usually be made in place as special preheating is seldom necessary.

Chase Chāmet* Bronze melts at 1625° F.; it flows freely, hardens without blowholes or porosity, and takes a high and brilliant finish. All Chase Welding Rod—in Chāmet* Bronze, Manganese Bronze and Brass—is guaranteed for satisfactory quality; look for the name Chase stamped on every length.

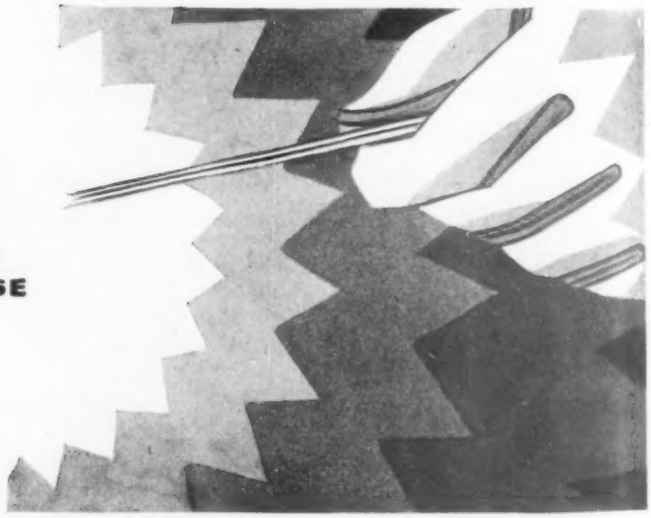
Chase Welding Rod is always ready for immediate delivery from any of our thirteen warehouses throughout the country.



*Chase Chāmet Bronze is a special bronze alloy developed in the Chase Laboratories. We have named it Chāmet to distinguish it from ordinary kinds of bronze. Full details of tensile strength, elasticity and machining properties gladly furnished on request.

CHASE WELDING ROD

Chase Manganese Bronze Welding Rod
Chase Chāmet Bronze Welding Rod
Chase Brass Welding Rod



CHASE

The mark that identifies good brass and copper products

CHASE BRASS & COPPER CO.
—INCORPORATED—
HOME OFFICE • WATERBURY, CONNECTICUT

And prompt deliveries always from the nearest of our thirteen Warehouses in New York · Boston · Newark · Philadelphia · Baltimore · Cincinnati Cleveland · Detroit · Chicago · St. Louis · New Orleans · Los Angeles San Francisco. (Also Branch Offices in Rochester, Pittsburgh and Dallas.)

The Welding Engineer

Founded by L. B. Mackenzie, 1916

Volume 14 | July, 1929 | Number 7

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Servants to the Buyer

The assistance given by advertisments to the buyer is multiple and varied.

An advertisement cooperates with intelligence. It awakens thought and stimulates good judgment. It does not use force, but reasons, persuades, criticizes.

It facilitates mental detail for the buyer by summarizing the facts which he requires for decision.

It is an assurance of the moral purpose and business sagacity of the advertiser.

It serves buyers located in out-of-the-way places where salesmen cannot afford to go.

It creates a larger demand, necessitates manufacture in larger quantities, keeps factories operating without losses due to slackening of orders, lowers the *per unit* cost of manufacture—and thus reduces the selling price.

These are established facts about the use of advertisements. They are servants to the buyer.

Careful purchasers in the welding industry have long realized the importance (and are regular readers) of the advertisements published in The Welding Engineer.

Published on the 15th of Each Month by

THE WELDING ENGINEER PUBLISHING CO.,
608 S. Dearborn St., Chicago, Ill.
Telephone Wabash 7134

G. H. Mackenzie.....President and Treasurer
H. S. Card.....Secretary

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A. W. Swift.....Associate Editor

Eastern Office—222 American Circle Bldg., New York. T. E. DePew, Eastern Manager. Telephone, Columbus 6941

Western Office—1244 Harper Ave., Los Angeles, Cal. Miles C. Smith, Western Manager.

Subscription payable in advance and postage free.
United States and possessions and Canada.....$3 a year
Foreign Countries .....$4 a year
Single copy, domestic .....35 cents
Single copy, foreign .....30 cents

Entered as second-class matter January 20, 1916, at the postoffice at Chicago, Illinois, under the act of March 3, 1879.

The Welding Engineer is a member of the Audit Bureau of Circulations and of the Associated Business Papers, Inc.

Last Advertising forms close at 8:00 a. m. on the 12th. To show proof for correction copy must be received at an earlier date and allowances should be made for delay to mails. All copy should be in by the 12th of the month at the latest.

The Welding Engineer does not publish in its news or advertising columns any matter that deals with or refers to either personal or legal controversies.

Authorized Representatives

CLEVELAND—R. K. Randall, 2094 E. 19th St.
DENVER—A. G. Odell, Public Opportunity School.
GREAT BRITAIN—Capt. D. Richardson, 26 Winterbrook Road, Herne Hill, London.
AUSTRALIA AND NEW ZEALAND—R. Hill, Matlock House, Davenport, Auckland, New Zealand.
SOUTH AFRICA—J. W. Armison, 35a Victoria Ave., Benoni, Transvaal, South Africa.

Buyers' Index

Readers of The Welding Engineer will find this index to contain the most accurate information obtainable relating to welding apparatus and supplies. The advertising section includes the principal manufacturers of the United States.

ACETYLENE (Compressed in Cylinders)
Air Reduction Sales Co.
Commercial Acetylene Supply Co.
Kansas City Oxygen Gas Co.
International Oxygen Co.
Prest-O-Lite Co.
Superior Oxy-Acetylene Co.

ACETYLENE CYLINDERS
Pressed Steel Tank Co.

ACETYLENE WELDING WIRE
Air Reduction Sales Co.
American Brass Co.
American Steel & Wire Co.
Atlas Foundry Co.
Central Steel & Wire Co.
Craftsweld Equipment Co.
Fusion Welding Corporation
E. D. Giberson & Co.
C. H. Hollup Corp.
Igoe Brothers
Imperial Brass Mfg. Co.
Kansas City Oxygen Gas Co.
Koro Corporation
Mueller Brass Co.
Oxweld Acetylene Co.
Page Steel & Wire Co.
Reid-Avery Co.
Roebling, John A., Sons Co.
Seneca Wire Mfg. Co.
St. Paul Welding & Mfg. Co.
Standard Steel & Wire Co.
Steel Sales Corp.
Stoody Co.
Joseph T. Ryerson & Sons, Inc.
Superior Oxy-Acetylene Co.
Taylor-Wharton Iron & Steel Co.
Torchweld Equipment Co.
Wickwire Spencer Steel Corp.
Weldit Acetylene Co.
Williams & Co.

AIR LIQUEFACTION OXYGEN PRODUCING PLANTS
Keith Dunham Company
Heylandt Sales Co.

ALUMINO-THERMIC WELDING
Metal & Thermit Corporation

ALUMINUM SOLDER
Crown Aluminum Solder Co.
Reynolds Metals Co.

ANNEALING FURNACES
General Electric Co.
Westinghouse Elec & Mfg. Co.

APRONS (Asbestos)
Ideal Face Shield Co.

ASBESTOS INSULATED WIRE AND CABLE
Central Steel & Wire Co.

BLOW PIPES
See "Torches."

BOOKS
The Welding Engineer Pub. Co.
General Electric Co.
Lincoln Electric Co.
Linde Air Products Co.
Electric Arc Cutting & Welding Co.
Larry Sherman & Co.

BRAZING OUTFITS
Air Reduction Sales Co.
Bastian-Blessing Co.
Craftsweld Equipment Co.
General Welding and Equipment Co.
Harris Calorific Co.
Imperial Brass Mfg. Co.
International Oxygen Co.
Kansas City Oxygen Gas Co.
K-G Welding & Cutting Co.
Alexander Milburn Co.
Modern Engineering Co.
Oxweld Acetylene Co.
Sight Feed Generator Co.
Superior Oxy-Acetylene Co.
Torchweld Equipment Co.
Victor Oxy-Acetylene Equipment Co.
Williams & Co.

BRONZE FILLER RODS
American Brass Co.
Central Steel & Wire Co.
Chase Brass and Copper Co., Inc.
Mueller Brass Co.
Oxweld Acetylene Co.
Steel Sales Corp.

BUFFERS
Biax Flexible Shaft Co.
R. G. Haskins Co.
N. A. Strand & Co.

BUTT WELDERS
See "Electric Resistance Welders"

CABLE (Arc Welding)
Allan Mfg. & Welding Co.
Central Steel & Wire Co.
Electric Arc Cutting & Welding Co.
General Electric Co.
Gibb Welding Machines Co.
C. H. Hollup Corp.
Lincoln Electric Co.
Quasi-Arc Weldtrode Co.
John A. Roebling Sons Co.
Joseph T. Ryerson & Sons, Inc.
Westinghouse Elec. & Mfg. Co.
Wilson Welder & Metals Co.

CARBIDE
Air Reduction Sales Co.
National Carbide Co.
Shawinigan Products Corp.
Superior Oxy-Acetylene Co.
Union Carbide Sales Co.

CARBON (Blocks, Paste, Electrodes, etc.)
Air Reduction Sales Co.
Central Steel & Wire Co.
Electric Arc Cutting & Welding Co.
National Carbon Co.
Oxweld Acetylene Co.

CARBON BURNING EQUIPMENT
Air Reduction Sales Co.
Bastian-Blessing Co.
Craftsweld Equipment Co.
Harris Calorific Co.
Imperial Brass Mfg. Co.
International Oxygen Co.
Kansas City Oxygen Gas Co.
K-G Welding & Cutting Co.
Milburn, Alexander Co.
Modern Engineering Co.
Oxweld Acetylene Co.
Superior Oxy-Acetylene Co.
Torchweld Equipment Co.
Victor Oxy-Acetylene Equipment Co.

CAST IRON SOLDER
Crown Aluminum Solder Co.
Superior Oxy-Acetylene Co.
Weldene Corporation

CAUSTIC POTASH
Innis, Speiden & Company

CUTTING ELECTRODES (Electric Arc)
Allan Mfg. & Welding Co.
Electric Arc Cutting & Welding Co.
General Electric Co.
Lincoln Electric Co.
National Carbon Co.
Westinghouse Elec. & Mfg. Co.
Wilson Welder & Metals Co.

CYLINDERS (Acetylene)
Pressed Steel Tank Co.

CYLINDERS (Oxygen, Hydrogen)
Chas. L. Gulick.
Wm. Wharton, Jr. Co.
Harrisburg Pipe & Pipe Bending Co.

DRILLS, PORTABLE ELECTRIC
Biax Flexible Shaft Co.
R. G. Haskins Co.
Stoody Company
N. A. Strand & Co.

ELECTRIC ARC WELDING OUTFITS
Allan Mfg. & Welding Co.
American Steel Engineering Co.
Burke Electric Co.
Chicago Steel & Wire Co.
Electric Arc Cutting & Welding Co.
Electric Welding Machine Co.
Fusion Welding Corporation
General Electric Co.
Goodman Electric Machinery Co.
Gibb Welding Machines Co.
Hobart Bros. Co.
C. H. Hollup Corp.
Lincoln Electric Co.
E. A. Lundy Co.
Northwestern Mfg. Co.
Owen Electric Mfg. Co.
Quasi-Arc Incorporated
Joseph T. Ryerson & Sons, Inc.
Stoody Co.
Superior Oxy-Acetylene Co.
Westinghouse Elec. & Mfg. Co.
Williams & Co.
Wilson Welder & Metals Co.

ELECTRIC RESISTANCE WELDERS
Federal Machine & Welder Co.
General Electric Co.
Gibb Welding Machines Co.
Goodman Electric Machinery Co.

ELECTRODES (Carbon Arc Welding)
See "Cutting Electrodes"

ELECTRODES (Metallic Arc Welding)
American Steel & Wire Co.
Atlas Foundry Co.
Central Steel & Wire Co.
Chicago Steel & Wire Co.
Electric Arc Cutting & Welding Co.
Fusion Welding Corporation
General Electric Co.
Gibb Welding Machines Co.
E. D. Giberson & Co.
C. H. Hollup Corporation
Igoe Brothers
Koro Corporation
Lincoln Electric Co.
National Welding Products Corp.
Page Steel & Wire Co.
Quasi-Arc Incorporated
Reid-Avery Co.
Roebling, John A., Sons Co.
Joseph T. Ryerson & Sons, Inc.
Seneca Wire Mfg. Co.
Standard Steel & Wire Co.
Steel Sales Corp.
Stoody Company
Taylor-Wharton Iron & Steel Co.
Wickwire Spencer Steel Corp.
Williams & Co.
Wilson Welder & Metals Co.

ELECTRODE HOLDERS
Allan Mfg. & Welding Co.
Burke Electric Co.
Chicago Steel & Wire Co.
Electric Welding Machine Co.
Fibre-Metal Products Co.
Fusion Welding Corporation
General Electric Co.
Gibb Welding Machines Co.
C. H. Hollup Corp.
Koro Corporation.
Lincoln Electric Co.
Northwestern Mfg. Co.
Owen Electric Mfg. Co.
Stoody Co.
Superior Oxy-Acetylene Co.
Westinghouse Elec. & Mfg. Co.
Williams & Co.
Wilson Welder & Metals Co.

ELECTRODE TIPS (Resistance Welding)
Elkon, Inc.

ELECTROLYTIC OXYGEN AND HYDROGEN GENERATING EQUIPMENT
International Oxygen Co.

FACE SHIELDS (Arc Welding)
Allan Mfg. Co. & Welding Co.
American Optical Co.
Burke Electric Co.
Central Steel & Wire Co.
Chicago Eye Shield Co.
Electric Arc Cutting & Welding Co.
Fibre-Metal Products Co.
General Electric Co.
Gibb Welding Machines Co.
C. H. Hollup Corp.
Ideal Face Shield Co.
Lincoln Electric Co.
Northwestern Mfg. Co.
Owen Electric Mfg. Co.
Quasi-Arc Incorporated
Stoody Company
Joseph T. Ryerson & Sons, Inc.
Sellstrom Mfg. Co.
Superior Oxy-Acetylene Co.
Westinghouse Elec. & Mfg. Co.
Williams & Co.
Wilson Welder & Metals Co.
Willson Products, Inc.

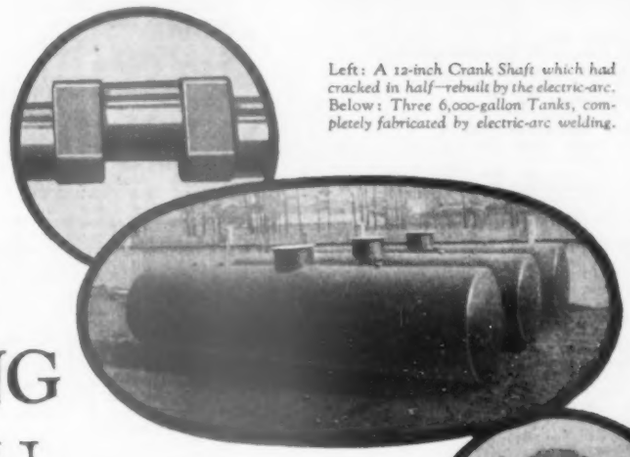
FIREPROOF PLASTIC MATERIAL
Air Reduction Sales Co.
National Carbon Co.

FLUE WELDERS (Electric)
General Electric Co.

FLUXES
Air Reduction Sales Co.
Anti-Borax Compound Co.
Kansas City Oxygen Gas Co.
Metal & Thermit Corp.
Central Steel & Wire Co.
Modern Engineering Co.
Oxweld Acetylene Co.
St. Paul Welding & Mfg. Co.
Superior Oxy-Acetylene Co.
Torchweld Equipment Co.
Weldit Acetylene Co.

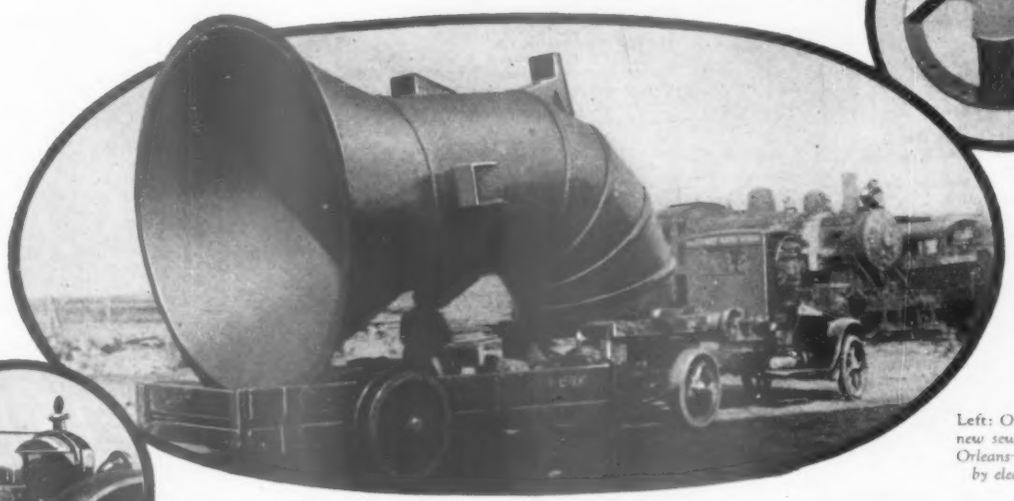
GAS SAVING DEVICES
Harris Calorific Co.
Weldit Acetylene Co.

The EXPERIENCE of Others *proves what* ARC-WELDING *can do for* YOU



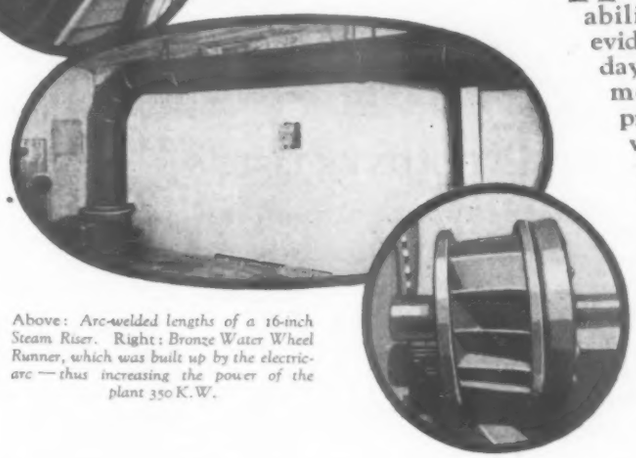
Left: A 12-inch Crank Shaft which had cracked in half—rebuilt by the electric-arc. Below: Three 6,000-gallon Tanks, completely fabricated by electric-arc welding.

Right: Generator Head, made of arc-welded structural steel units.



Left: One of the units in the new sewage system of New Orleans—entirely fabricated by electric-arc welding.

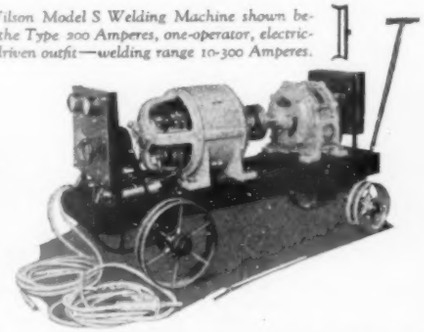
Left: Cracked Cylinder Block, repaired by electric-arc welding.



Above: Arc-welded lengths of a 16-inch Steam Riser. Right: Bronze Water Wheel Runner, which was built up by the electric-arc — thus increasing the power of the plant 350 K.W.

HERE is evidence of the remarkable versatility and dependability of electric-arc welding—evidence that is piling up day after day, and in every industry where metals are being joined. Here is proof that—whatever *your* industry, whatever *your* welding problems—you can profit by the manifold advantages of arc welding. ¶ Pioneers in electric-arc welding—Wilson places at your disposal its great accumulation of welding experience and knowledge. You are invited to consult its engineers—no obligation.

The Wilson Model S Welding Machine shown below is the Type 200 Amperes, one-operator, electric-motor-driven outfit—welding range 10-300 Amperes.



WILSON WELDER & METALS CO. INC., 20 WILSON BUILDING, HOBOKEN, N. J.

WILSON

WELDING MACHINES AND WELDING WIRE

GLOVES (Asbestos)
Ideal Face Shield Co.
GAUGES
Moto Meter Co.
National Gauge & Equipment Co.
GENERATORS (Acetylene)
Air Reduction Sales Co.
Bastian-Blessing Co.
Brooks Machine Co.
Craftsweld Equipment Co.
Imperial Brass Mfg. Co.
Harris Calorific Co.
Milburn, Alexander Co.
Modern Engineering Co.
Oxweld Acetylene Co.
Sight Feed Generator Co.
GLOVES
Morrison-Ricker Mfg. Co.
GOGGLES
American Optical Co.
Chicago Eye Shield Co.
Ideal Face Shield Co.
Sellstrom Mfg. Co.
Willson Products, Inc.
GRINDERS (Portable Electric)
R. G. Haskins Co.
Stoody Company.
N. A. Strand & Co.
HELMETS (Arc Welding)
Allan Mfg. & Welding Co.
American Optical Co.
Burke Electric Co.
Central Steel & Wire Co.
Chicago Eye Shield Co.
Electric Arc Cutting & Welding Co.
Fibre-Metal Products Co.
Fusion Welding Corporation
General Electric Co.
Gibb Welding Machines Co.
C. H. Hollup Corp.
Ideal Face Shield Co.
Lincoln Electric Co.
Northwestern Mfg. Co.
Owen Electric Mfg. Co.
Quasi-Arc Incorporated
Sellstrom Mfg. Co.
Superior Oxy-Acetylene Co.
Westinghouse Elec. & Mfg. Co.
Williams & Co.
Wilson Welder & Metals Co.
Willson Products, Inc.
HYDROGEN
Gas Products Association
International Oxygen Co.
HYDROGEN GENERATING PLANTS
International Oxygen Co.
LEAD WELDING UNITS
Air Reduction Sales Co.
Bastian-Blessing Co.
Craftsweld Equipment Co.
Sellstrom Mfg. Co.
Imperial Brass Mfg. Co.
International Oxygen Co.
Kansas City Oxygen Gas Co.
K-G Welding & Cutting Co.
Modern Engineering Co.
Milburn, Alexander, Co.
Oxweld Acetylene Co.
Superior Oxy-Acetylene Co.
Torchweld Equipment Co.
Victor Oxy-Acetylene Equipment Co.
Weldit Acetylene Co.
LIGHTERS (For Gas Torches)
Air Reduction Sales Co.
Bastian-Blessing Co.
Harris Calorific Co.
Imperial Brass Mfg. Co.
International Oxygen Co.
K-G Welding & Cutting Co.
Kansas City Oxygen Gas Co.
Michigan Matchless Utilities Co.
Milburn, Alexander, Co.
Modern Engineering Co.
Oxweld Acetylene Co.
Safety Gas Lighter Co.
Shoot-a-Lite Corporation.
Superior Oxy-Acetylene Co.
Torchweld Equipment Co.
MANIFOLDS
Air Reduction Sales Co.
Bastian-Blessing Co.
Craftsweld Equipment Co.
General Welding and Equipment Co.
Harris Calorific Co.
Imperial Brass Mfg. Co.
International Oxygen Co.
Kansas City Oxygen Gas Co.
K-G Welding & Cutting Co.
Milburn, Alexander, Co.
Modern Engineering Co.
Oxweld Acetylene Co.
Superior Oxy-Acetylene Co.
Torchweld Equipment Co.
Victor Oxy-Acetylene Equipment Co.
MECHANICALLY OPERATED CUTTING AND WELDING TORCHES
Air Reduction Sales Co.
General Welding and Equipment Co.
Oxweld Acetylene Co.
Torchweld Equipment Co.
MOLDING MATERIAL
See "Fire Proof Plastic Material"
MONEL METAL RODS AND ELECTRODE
Central Steel & Wire Co.
Wilson Welder & Metals Co.
NEEDLE VALVES
Air Reduction Sales Co.
Bastian-Blessing Co.
Harris Calorific Co.
Imperial Brass Mfg. Co.
International Oxygen Co.
Kansas City Oxygen Gas Co.
K-G Welding & Cutting Co.
Milburn, Alexander, Co.
Modern Engineering Co.
Oxweld Acetylene Co.
Torchweld Equipment Co.
Victor Oxy-Acetylene Equipment Co.
NICHROME WELDING WIRE
Driver-Harris Co.
NITROGEN
Air Reduction Sales Co.
Gas Products Association
Linde Air Products Co.
International Oxygen Co.
OXYGEN
Air Reduction Sales Co.
Gas Products Association
Kansas City Oxygen Gas Co.
International Oxygen Co.
Linde Air Products Co.
Superior Oxy-Acetylene Co.
PIPE BENDING MACHINES
American Pipe Bending Machine Co.
PIPE BENDS AND COILS
Harrisburgh Pipe and Pipe Bending Co.
PORTABLE ARC WELDING OUTFITS (Mounted on Trucks)
General Electric Company
Chicago Steel & Wire Co.
Electric Arc Cutting & Welding Co.
Hobart Bros. Co.
Lincoln Electric Co.
Northwestern Mfg. Co.
Joseph T. Ryerson & Sons, Inc.
Wilson Welder & Metals Co.
Westinghouse Electric & Mfg. Co.
Shrader Electric Company
PREHEATING DEVICES AND OVENS
Imperial Brass Mfg. Co.
Metal & Thermit Corp.
St. Paul Welding & Mfg. Co.
REAMERS (Portable Electric)
R. G. Haskins Co.
N. A. Strand & Co.
REGULATORS
Air Reduction Sales Co.
Bastian-Blessing Co.
Craftsweld Equipment Co.
Fusion Welding Corporation
General Welding and Equipment Co.
Harris Calorific Co.
Imperial Brass Mfg. Co.
International Oxygen Co.
Kansas City Oxygen Gas Co.
K-G Welding & Cutting Co.
Milburn, Alexander, Co.
Modern Engineering Co.
Oxweld Acetylene Co.
St. Paul Welding & Mfg. Co.
Joseph T. Ryerson & Sons, Inc.
Sight Feed Generator Co.
Stoody Company
Superior Oxy-Acetylene Co.
Torchweld Equipment Co.
Victor Oxy-Acetylene Equipment Co.
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Williams & Co.
SCORED CYLINDER REPAIR MATERIALS
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Metal & Thermit Corp.
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Oxweld Acetylene Co.
Joseph T. Ryerson & Sons, Inc.
Sight Feed Generator Co.
St. Paul Welding & Mfg. Co.
Stoody Company
Superior Oxy-Acetylene Co.
Torchweld Equipment Co.
Victor Oxy-Acetylene Equipment Co.
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Williams & Co.
TRUCKS (Cylinder)
Air Reduction Sales Co.
Imperial Brass Mfg. Co.
International Oxygen Co.
Sight Feed Generator Co.
Superior Oxy-Acetylene Co.
Torchweld Equipment Co.
VALVES
Air Reduction Sales Co.
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Air Reduction Sales Co.
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Fine workmanship with fine materials produces the finest tanks

HERE are range boilers and storage tanks in all sizes, welded in a plant where inspection is rigid and where a "return" is absolutely unknown. Only by using the best of methods and materials can such standards of production be maintained. In plants like this you will find Swedox Welding Wires enjoy an enviable reputation for quality and reliability.

Central Steel & Wire Company

CHICAGO, ILL.
4545 S. Western Blvd.
Lafayette 8500

DAYTON, OHIO
East Monument Ave. Extended
East 150

DETROIT, MICH.
5001 Bellevue Ave.
Whittier 6780

SWEDOX

WELDING RODS, WIRES and ELECTRODES

"Here, Lad—

I agree with you that we need an arc welder all right for the new power plant job.

But what boils me is that the maintenance engineer insists that I cancel the order I issued for the welder and get a Lincoln instead.

You go down and see whether it's just a pipe dream that has him up in the air."

"Right, Pop—

pipe is right.

You see a lot of the welding he is to do is away up in the air on overhead piping.

With a Lincoln machine, it's possible to adjust the welding heat for the job and go up the ladder with assurance that no further adjustments are necessary.

And when an operator is up 43 feet and has to come down every few minutes to adjust the welding heat — it's disconcerting enough to lead to profanity.

The only economy you could get from the other machine is the saving on money you would spend for theatre tickets to hear cussing on the stage that can't hold a candle to that of an operator dividing his time between welding and adjusting."

The Lincoln Electric Co.,
Dept. No. 27-7, Cleveland, Ohio

W-102

The Lincoln "Stable-Arc" Welder

— welds easier
— makes better welds
— permits greater output

because of the steady uniform arc throughout entire welding range, which is the result of:

Variable voltage design
Laminated magnetic circuit
Separately-excited generator field
Double control of welding heat
All steel construction

No other welder has all these features.

LINCOLN "Stable Arc" WELDER

Everybody's Neighbor

230 UNION CARBIDE warehouses situated in important trade centers throughout the country are at your service. An adequate stock is always on hand at every unit in this nation-wide distributing system. Large shipments are constantly enroute from Carbide Plants to these warehouses.

This enables *you* to get Union Carbide deliveries when you want them.

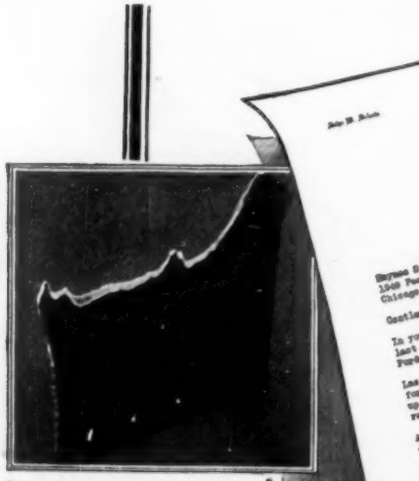
Union Carbide is shipped the day order is received.

UNION CARBIDE SALES COMPANY

Unit of Union Carbide and Carbon Corporation

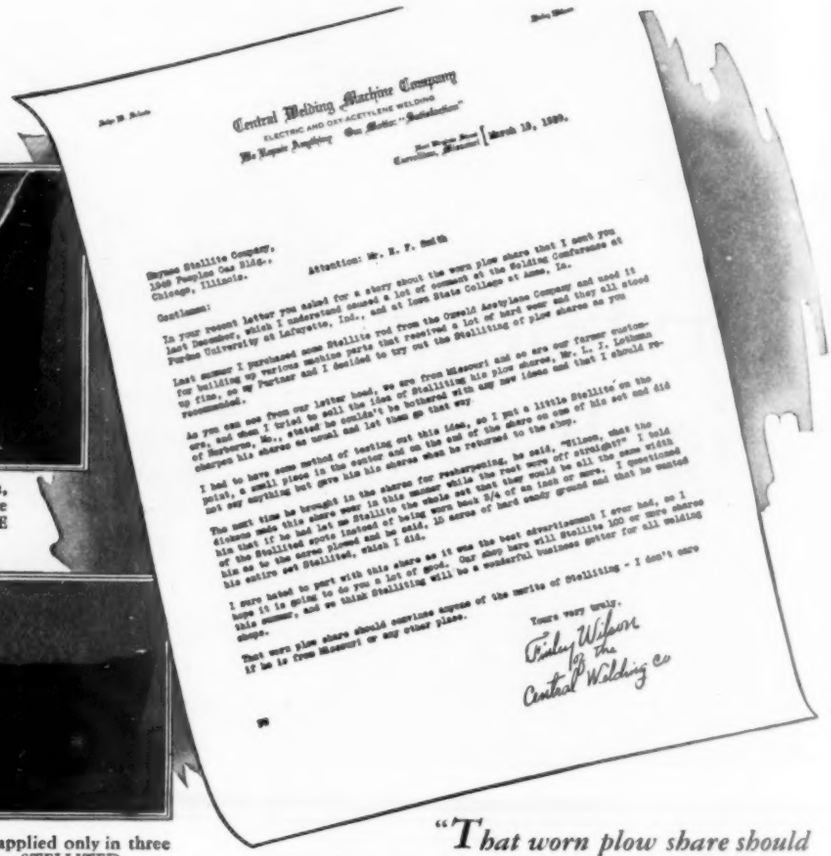
UCC

New York	Chicago	San Francisco
Carbide and Carbon Bldg.	Peoples Gas Bldg.	Adam Grant Bldg.



Note thickness where worn, as compared with sharp edge where HAYNES STELLITE was applied.

HAYNES STELLITE was applied only in three spots. Note how the unSTELLITED balance wore.



Central Welding Machine Company

ELECTRIC AND OXY-ACETYLENE WELDING

Our Motto: "Satisfaction"

Carrollton, Missouri, March 19, 1929.

Haynes Stellite Company,
1949 Peoples Gas Bldg.,
Chicago, Illinois.

Attention: Mr. E. F. Smith

Gentlemen:

In your recent letter you asked for a story about the worn plow share that I sent you last December, which I understand caused a lot of comment at the Welding Conference at Purdue University at Lafayette, Ind., and at Iowa State College at Ames, Ia.

Last summer I purchased some Stellite rod from the Oxweld Acetylene Company and used it for building up various machine parts that received a lot of hard wear and they all stood up fine, so my partner and I decided to try out the Stelliting of plow shares as you recommended.

As you can see from our letter head, we are from Missouri and so are our former customers, and when I tried to sell the idea of Stelliting his plow shares, Mr. L. J. Lothman of Norborne, Mo., stated he couldn't be bothered with any new ideas and that I should resharpen his shares as usual and let them go that way.

I had to have some method of testing out this idea, so I put a little Stellite on the point, a small piece in the center and on the end of the share so one of his set and did not say anything but gave him his shares when he returned to the shop.

The next time he brought in the shares for resharpening, he said, "Wilson, what the dickens made this share wear in this manner while the rest were off straight?" I told him that if he had let me Stellite the whole set that they would be all the same width of the Stellited spots instead of being worn back 3/4 of an inch or more. I questioned him as to the acres plowed and he said, 10 acres of hard sandy ground and that he wanted his entire set Stellited, which I did.

I sure hated to part with this share as it was the best advertisement I ever had, so I hope it is going to do you a lot of good. Our shop here will Stellite 100 or more shares this summer, and we think Stelliting will be a wonderful business getter for all welding shops.

That worn plow share should convince anyone of the merits of Stelliting - I don't care if he is from Missouri or any other place.

Yours very truly,

Findley Wilson
for The
Central Welding Co

"That worn plow share should convince anyone of the merits of Stelliting.

"It's the best advertisement I ever had," says Mr. Wilson—"and here's the reason why. Plowing 15 acres of hard sandy ground had no effect on the Stellited portion of the cutting edge. The Stellited edge remained sharp and full width, but the unStellited edge wore away three quarters of an inch or more and became very dull."

Stellited plow shares stay sharp—scour immediately and stay in the ground. They plow five and a half times more acreage than standard steel shares.

Ask for the new Haynes Stellite folder, "Share in More Profits—By Stelliting Plow Shares."

HAYNES STELLITE COMPANY

Unit of Union Carbide and Carbon Corporation

UCC

DISTRICT SALES OFFICES

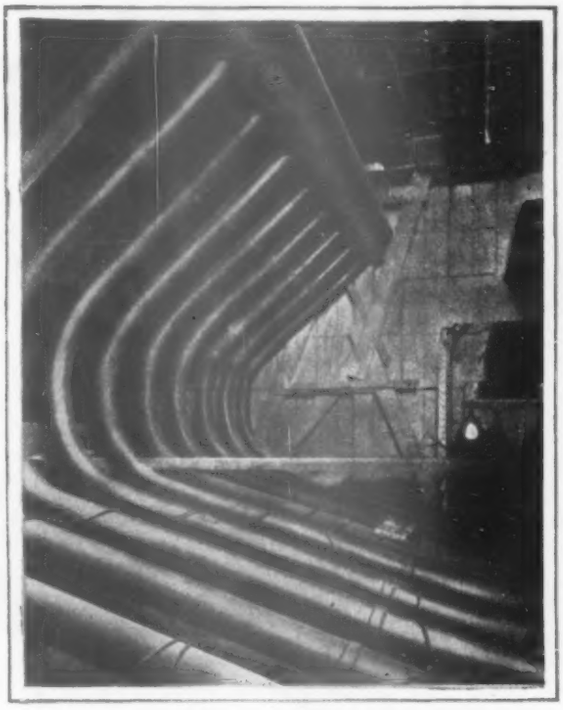
Chicago—Carbide and Carbon Bldg. Cleveland—628 Keith Bldg.
Detroit—4-240 General Motors Bldg.
Houston—6119 Harrisburg Bldg.
Los Angeles—1310 Santee Street New York—30 East 42nd Street
San Francisco—114 Sansome Street
Tulsa—Exchange National Bank Bldg.

General Offices—Kokomo, Indiana

Haynes Stellite welding rod is also available from any of the 28 District Sales Offices of Oxweld Acetylene Company

Stelliting with

HAYNES STELLITE



-*for* welding in any position

A mercury-vapor unit delivering 10,000 kw. in high-pressure steam and 10,000 kw. in electric energy is in service at the South Meadow station of the Hartford Electric Light Company. All welds in the vapor pipes and main mercury-vapor header were made with G-E arc-welding sets and G-E Type "F" electrode. When tested under 100 pounds of air per square inch, only three pinhole leaks were found in 80 such welds.

Type "F" electrode demonstrated more than its ability to effect pressure-tight welds. It was, in turn, applied in flat, vertical, horizontal, and overhead positions. Operators appreciate an electrode which is easily handled in awkward positions and which, at the same time, gives uniform results.

For prompt service or additional information as to various types of G-E electrodes, get in touch with the G-E welding Electrode Distributor near you or write to Section E- 537 , Merchandise Department, General Electric Company, Bridgeport, Connecticut.

In simplicity, reliability, and ease of operation, G-E arc-welding sets are unequalled. They are available in all sizes, all types—for either hand or automatic operation—for one or more operators.

550-517

JOIN US IN THE GENERAL ELECTRIC HOUR, BROADCAST EVERY SATURDAY AT 8 P.M., E.S.T. ON A NATION-WIDE N.B.C. NETWORK

GENERAL ELECTRIC

MERCHANDISE DEPARTMENT, BRIDGEPORT, CONNECTICUT

An Amazing New Production Tool

A most unusual but highly successful installation. Welding high-pressure boilers at the Connelly Boiler Company, Cleveland, Ohio. Dimensions are 22 ft. by 3½ ft. by ½ in. The heads are ⅝ in. The efficiency of the welds tests to an average of 97 per cent.

Welding an Ascoloy case-hardening tank at the Boom Boiler & Welding Co., Cleveland, Ohio. The job-welding business of this manufacturer has increased swiftly since the installation of the atomic welder. Unsolicited work comes in from miles around. Welding aluminum candy-cooking kettles, building up high-speed steel dies, repairing special electric-furnace electrodes—no job is too difficult.

JOIN US IN THE GENERAL ELECTRIC HOUR, BROADCAST EVERY SATURDAY AT 8 P.M., E.S.T. ON A NATION-WIDE N.B.C. NETWORK

GENERAL

GENERAL ELECTRIC COMPANY, SCHENECTADY, N. Y.

Atomic-Hydrogen Arc Welding

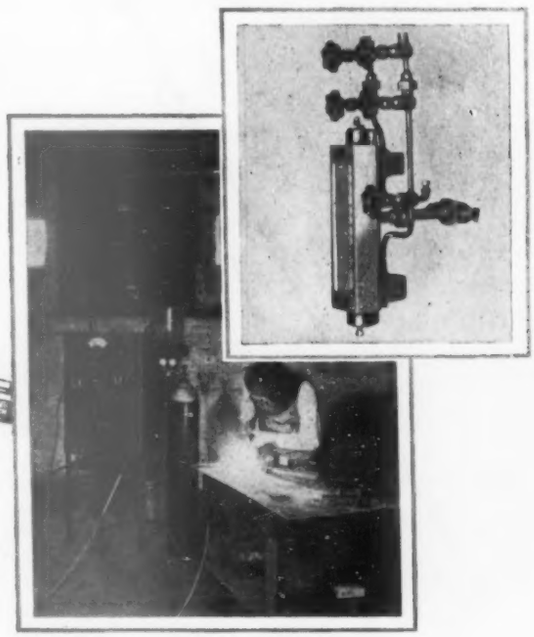
DEVELOPED originally by General Electric to weld very thin metals, and metals and alloys hitherto considered unweldable, the atomic-hydrogen arc welder, in the hands of inquisitive users, has become a production tool of amazing potentialities.

Of special interest to industry is the practice of using the atomic-hydrogen process for general welding. So exceptional are the results produced that users are perfectly willing to pay the slightly increased operating cost involved.

We show here the results being obtained with this new welder in a half-dozen representative plants in a single city. If you are interested, we cordially invite you to visit our installations at the Schenectady works, or call up our welding specialist in the nearest G-E office. He will show you local installations and give you complete data.

The list of unusual welded-repair jobs performed by the Cleveland General Electric service shop, since the installation of its atomic welder, reads like a magician's repertoire. Thousands of dollars were saved for one customer because this equipment made it possible to repair oil-leaks in transformer tanks.

The Perfection Stove Company, Cleveland, Ohio, is one of the largest users to date of this new process. Six equipments are used in the fabrication of parts for refrigerators made by this company. Much faster welding speeds and a quality of weld never before obtainable are the reasons.



The Meriam Co., a prominent Cleveland engineering firm, is marketing a high-temperature, high-pressure indicating flowmeter fabricated entirely by the atomic-hydrogen arc welder. Every other welding method failed on this job. Furthermore, the smooth weld resulting from this new method obviates any machining before painting.

530-64

ELECTRIC

SALES OFFICES IN PRINCIPAL CITIES

Dependable High-Strength Welds

HIGHER stresses — greater pressures — the insistent demands of industry for stronger steels steadily increase the importance of dependable high strength welds.

Oxweld has contributed much to the dependability of such welding by developing high quality welding rods which produce uniformly strong joints. Oxweld No. 1 High Test Welding Rod is an example. With this rod any operator can make considerably tougher, more ductile welds of approximately 20% greater tensile strength than with mild steel rod.

All Oxweld Welding Rods are manufactured to meet rigid specifications. Actual welding tests are made of every lot before it is stamped with the Oxweld trademark.

OXWELD

WELDING AND CUTTING APPARATUS AND SUPPLIES

OXWELD ACETYLENE COMPANY

Unit of Union Carbide and Carbon Corporation

NEW YORK, 30 E. 42d St. UCC CHICAGO, Peoples Gas Bldg.
SAN FRANCISCO, Adam Grant Building
IN CANADA, Dominion Oxygen Company, Toronto

STOCKS IN 38 CITIES

HARRISBURG

FORGED SEAMLESS STEEL CYLINDERS

Harrisburg Pipe & Pipe Bending Co.
Harrisburg, Pa.

EXCLUSIVE SALES AGENTS

Charles L. Gulick, Room 1709, 110 E. 42nd St., New York City, N. Y.

Joseph A. Janney, Jr., Morris Building, Philadelphia, Pa.

Fully Equipped with Our Own Open Hearth Furnaces, Rolling Mills and Forge Shops

Makers of Alloy Steels in Slabs, Billets, Bars, Strips, Shapes and Hollow Forgings: Pipe Coils and Bends, Couplings and Cylinders.

AMERICAN WELDING SOCIETY

INSTITUTE *of* METALS DIVISION A.I.M.E.

IRON *and* STEEL DIVISION A.S.M.E.

IRON *and* STEEL DIVISION A.I.M.E

AMERICAN SOCIETY FOR STEEL TREATING

National Metal Congress

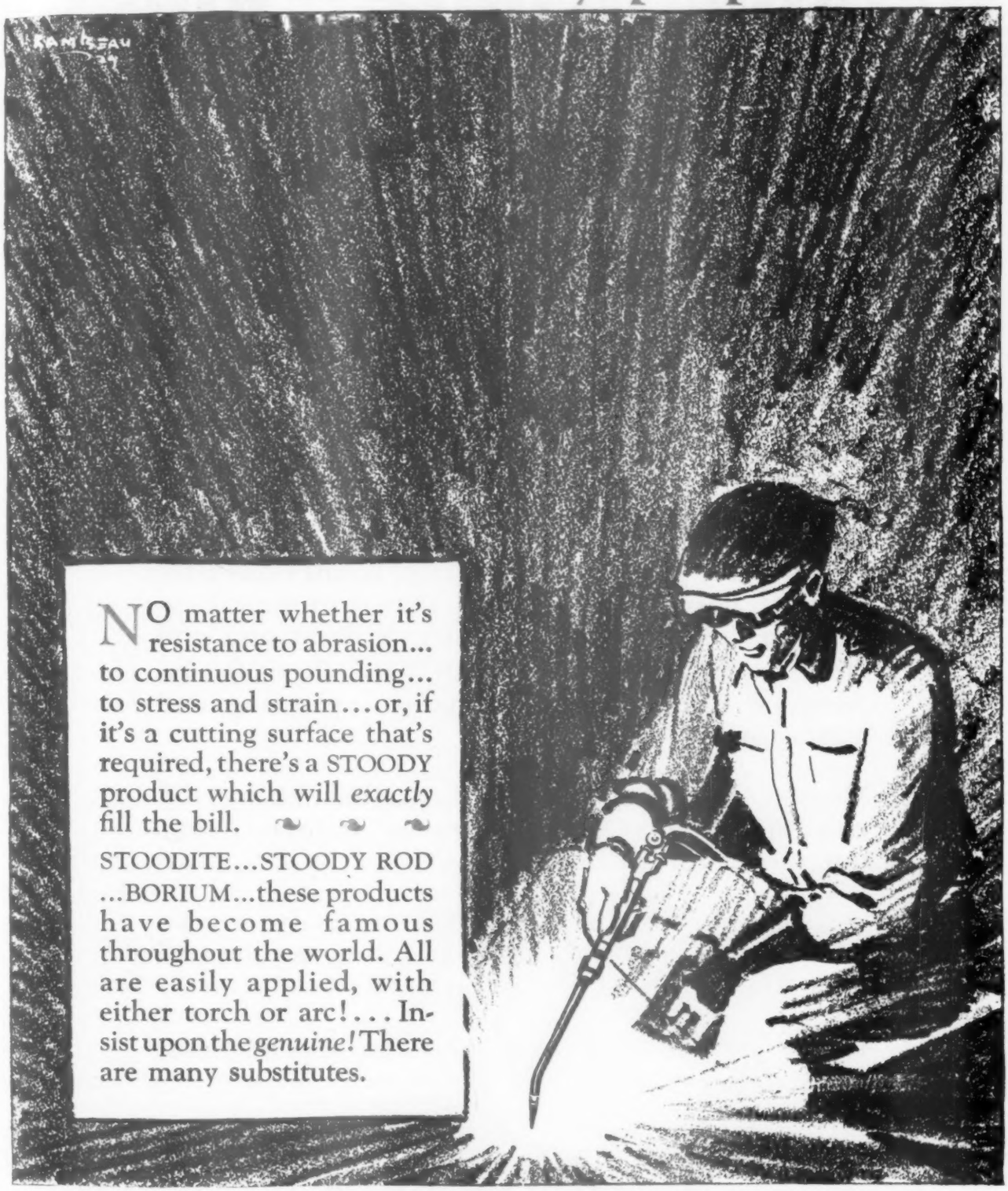
The greatest gathering of metal experts that has ever taken place in this country or the world, will assemble in

CLEVELAND
week of September 9th

when five leading technical societies of the metal working industries will hold their annual meetings. Simultaneously with these sessions, there will be held, in Cleveland the eleventh annual

NATIONAL METAL EXPOSITION

There's a STOODY Hard Facing Metal for every purpose



NO matter whether it's resistance to abrasion... to continuous pounding... to stress and strain... or, if it's a cutting surface that's required, there's a STOODY product which will *exactly* fill the bill.

STOODITE...STOODY ROD ...BORIUM...these products have become famous throughout the world. All are easily applied, with either torch or arc!... Insist upon the *genuine!* There are many substitutes.

STOODY COMPANY

Manufacturers of WELDING ROD • ALLOY STEEL • EQUIPMENT

Whittier, California

You Can Bank on Mueller Welding Bronze — and on Mueller Service

YOU will find that Mueller Welding Bronze Rod will give you the same definite result time after time. It has all the qualities that you would expect to find in a real product. It is strong and close grained . . . It melts easily and flows freely. Absence of porosity eliminates sputtering and explosions.

Mueller Welding Rod is distinguished by the wording "Mueller Welding Bronze" stamped every few inches on the rod itself.

For a special job that must machine easily or take a high finish — or for any job — you can depend on it to give you the results you must have.

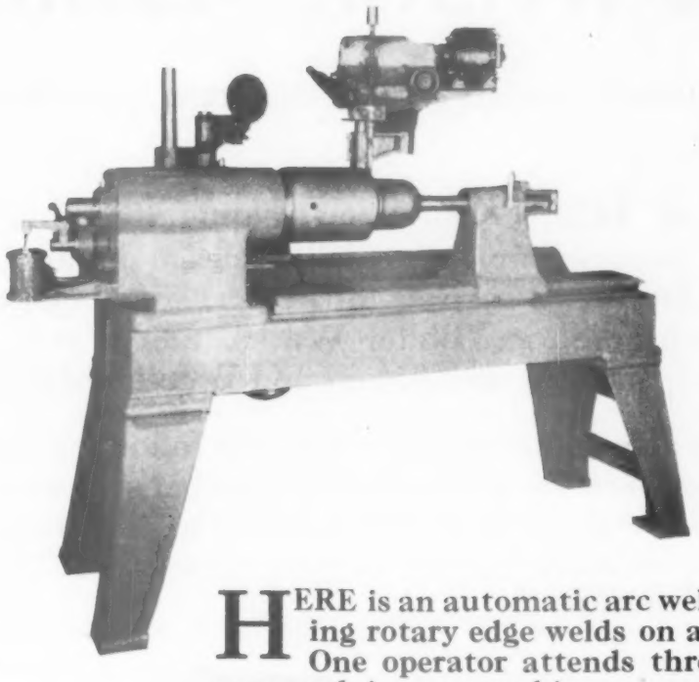
When you are in a hurry you can depend upon quick delivery, too.

Mueller Brass Co.
PORT HURON MICHIGAN

THREE GENERATIONS OF BRASS MAKING

KORO Processed Welding Wire for Automatic Welding Has the Distinctive Appearance Shown Below

LOWERING manufacturing costs



HERE is an automatic arc welding machine making rotary edge welds on automobile mufflers; One operator attends three machines, places new work in one machine, presses a button and goes on to the next. The welding wire *has* to be right. KORO Automatic High Speed Electrodes hold the efficiency record for this work. If you have an automatic welder, try this electrode and see what a difference it makes.

KORO CORPORATION
WAUKEGAN, ILLINOIS

"KORO"
(Patent applied for)

AUTOMATIC WELDING WIRE

Re-reeled for use on all types of automatic and semi-automatic arc welding machines.

Write for booklet describing the complete KORO line of wire for gas and electric welding

KORO Processed Welding Wire for Automatic Welding Has the Distinctive Appearance Shown Below

Owen Induction Arc Welding Machines

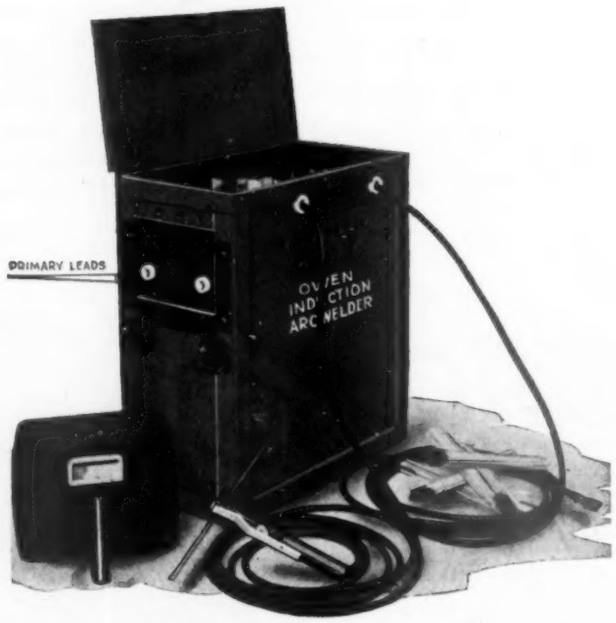
give superior welds on cast iron, malleable iron and steel.

Since July 1924, Owen Arc Welding Machines have been rendering twenty-four hour daily service in all branches of American industries such as, Structural Steel Plants, Railroad Shops, Machine Shops, Boiler Works, Ship Yards, Foundries, Saw Works, Garages, and Cotton and Woolen Mills.

Owen Welders manufactured in the following capacities are listed as standard by the Underwriters Laboratories: 50 to 150 amp., 50 to 200 amp., 50 to 300 amp., 50 to 400 amp., to operate from any convenient voltage supply; namely, 110-220, 220-440, or 550 volt circuits.

NOTICE

Owen Welders are manufactured in Fayetteville, N. C., *only.* They are not now and never have been manufactured in Omaha, Nebraska, neither have we any representation in the Omaha territory.



— Distributors Wanted —

Address all communications to

OWEN ELECTRIC MANUFACTURING COMPANY

Fayetteville North Carolina

(Exclusive Manufacturers of the Owen Patented Arc Welding Equipment)

It Forms Easily... Welds Fast and Firmly... *and Endures*

..that's why the City of Detroit chose ARMCO Ingot Iron for this important pipe line

THE reasons that are influencing welding shops to use and recommend ARMCO Ingot Iron are the same reasons that prompted the City of Detroit to specify this pure iron for its newest water supply line.

This important project calls for 9300 feet of 54 inch diameter ARMCO Ingot Iron pipe, ½ inch thick. The nearly two miles of pipe will be of welded and riveted construction.

ARMCO Ingot Iron was chosen for its uniformity, corrosion resistance, and long-time dependability. Its splendid record in similar and even more rigorous types of service convinced these exacting users that *pure iron* would best meet their requirements.

Practically every problem that welding shops encounter can be solved with ARMCO Ingot Iron. If fabrication is the major consideration, pure iron can be depended on to help you turn out the kind of job that decreases time-and-labor costs and at the same time satisfies exacting customers.

Being uniformly pure, soft and ductile, ARMCO Ingot Iron shears easily, forms quickly and surely, and welds rapidly, smoothly and strongly.

On the other hand, if it's a question of durability, ARMCO Ingot Iron's freedom from rust-promoting impurities is the answer. Deferred replacements, long, low-cost service—you can assure your customers of these desirable features.

From welding rods and electrodes to the largest plates, there is an ARMCO Ingot Iron product for your every metal need. Ask the district office nearest you for complete information on the material in which you are particularly interested.

ARMCO

THE AMERICAN ROLLING MILL CO.
Executive Offices: Middletown, Ohio
Export: The ARMCO International Corporation
Cable Address—ARMCO, Middletown (O)
DISTRICT OFFICES:

Chicago, Cincinnati, Cleveland, Detroit, New York, Philadelphia, Pittsburgh, St. Louis, San Francisco

ARMCO INGOT IRON RESISTS RUST

ELECTRIC WELDING

REQUIRES AN EFFICIENT TRANSFORMER

In choosing the transformer for your welding machine, three factors are of utmost importance:

1. Flexibility—(to suit any circuit).
2. Reliability—(24 hour service, without interruption, if necessary).
3. Economy—(long life with a minimum of repairs).

The American Transformer Company has consistently endeavored to uphold these standards of efficiency. In the welding industry they have closely followed each new development. The result is a staff of engineers competent to advise you on your electric welding problem regardless of its unusualities. Their advice entails no obligation, of course.

AMERICAN TRANSFORMER COMPANY
174 Emmet St., Newark, N. J.

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Montreal, Canada
W. O. Taylor & Co., Ltd.
415 Canada Cement B'ldg.

Minneapolis, Minn.
Elliott Equipment Co.
708-6th Avenue, South

San Francisco, Calif.
James H. Southard
682 Mission Street

Chicago, Ill.
L. C. Herrmann
4433 North Richmond St.
Ravenswood Station

Knoxville, Tenn.
Arthur L. Pollard

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112 South 16th Street

St. Louis, Mo
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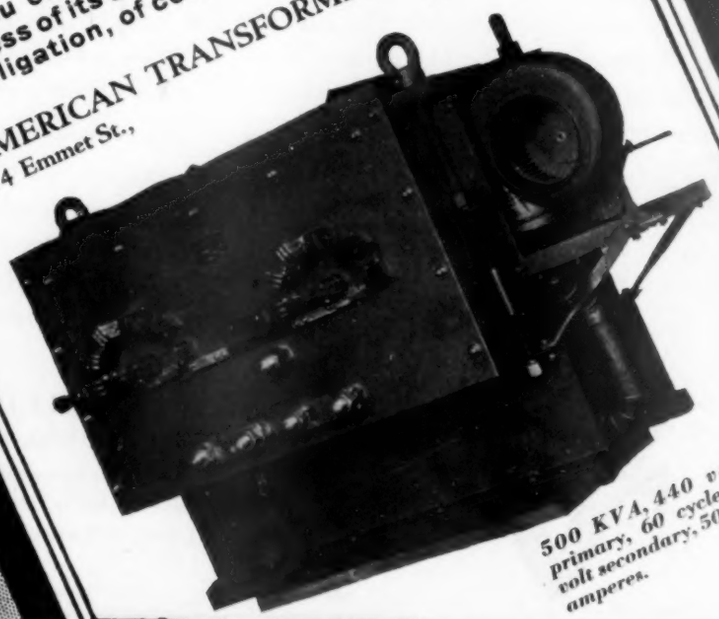
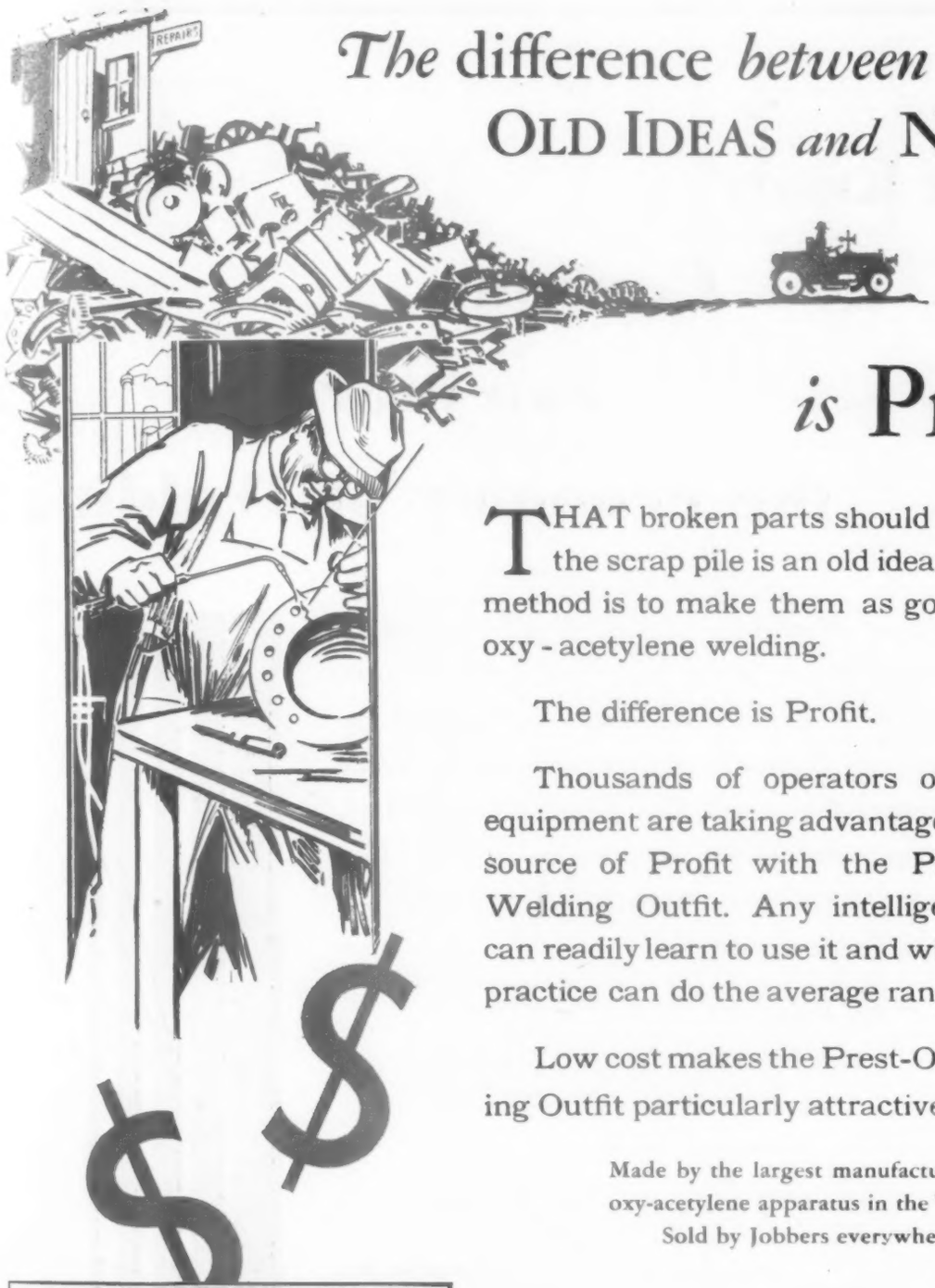
432 Pennant B'ldg.

Atlanta, Ga.
H. Douglas Stier
101 Marietta St.



500 KVA, 440 volt primary, 60 cycle 10 volt secondary, 50,000 amperes.

AMERICAN TRANSFORMER



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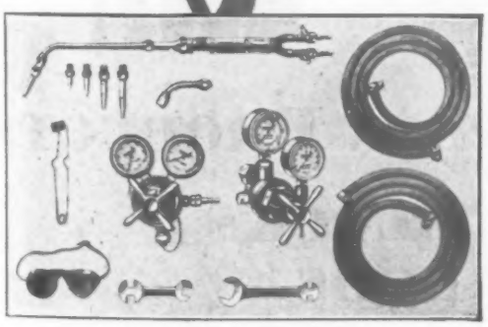

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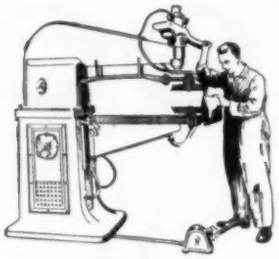

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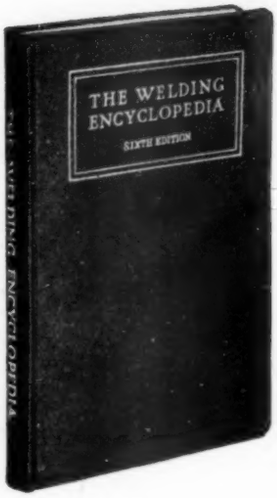

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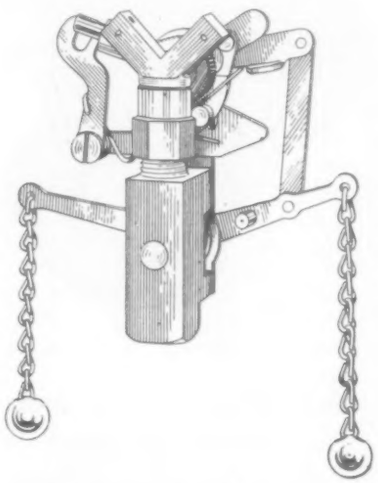

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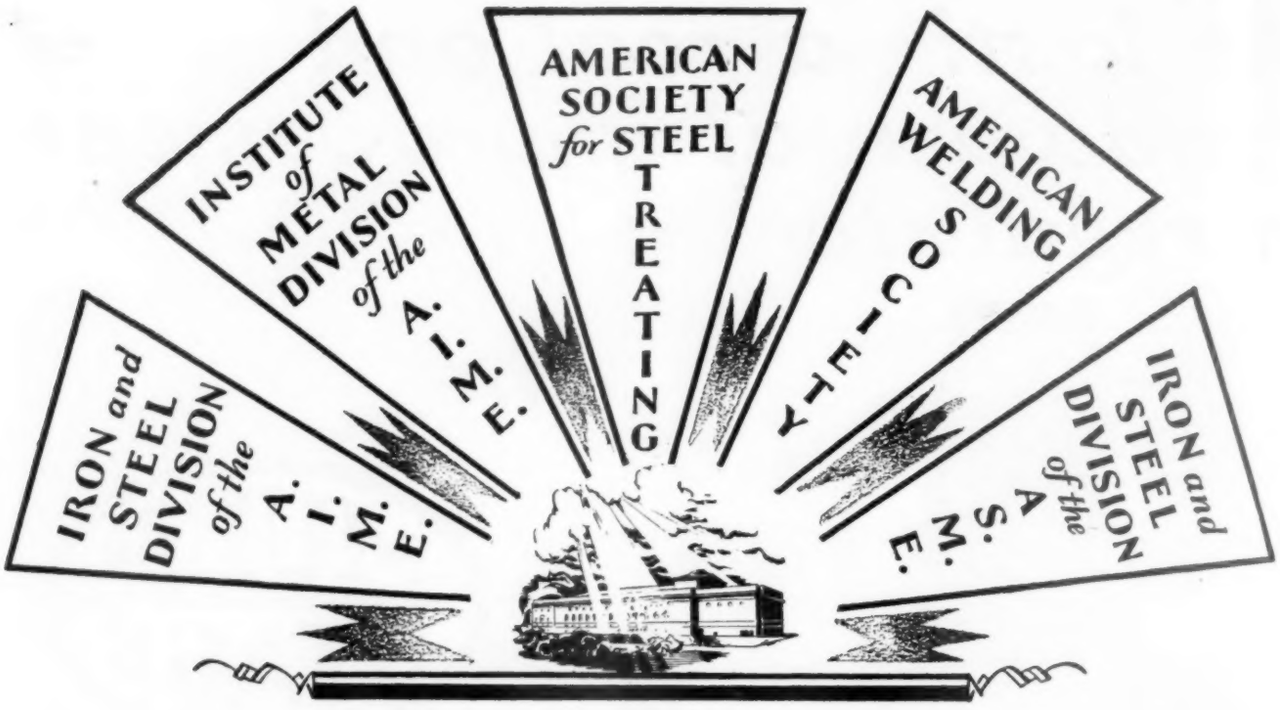
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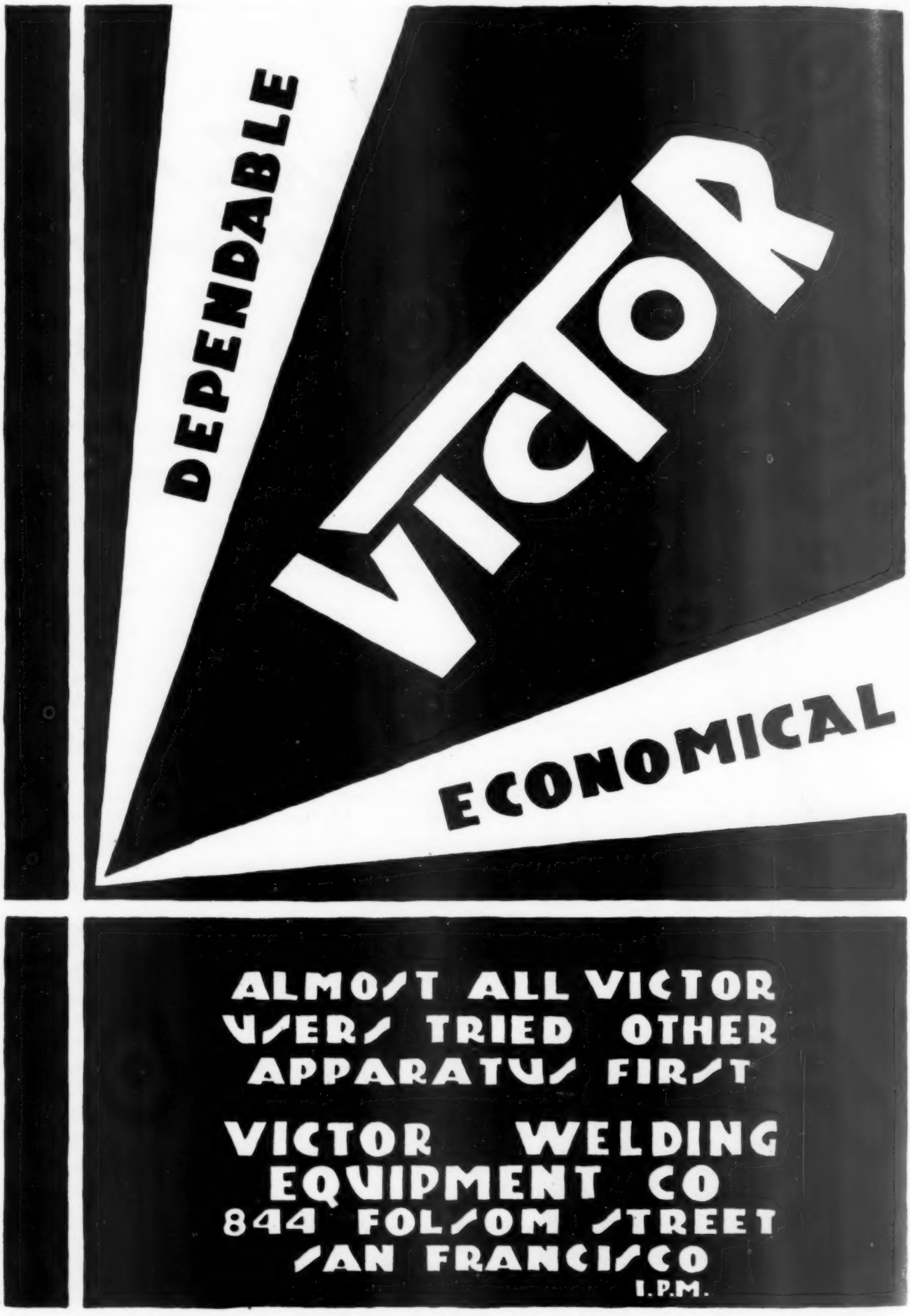
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EDITORIAL

Pneumonia and the Fire Department

MEN who are using oxygen every working day of their lives probably do not begin to realize the full possibilities of its use although it has become so important industrially that if the supply were suddenly cut off practically all industry would be at a standstill. It does not seem as though enough attention has been paid to its usefulness in saving lives. In a recent subway accident in New York City, the cutting torch was used on a real mission of mercy in the removal of injured persons from steel coaches. Many fire departments know the value of the cutting torch in rescue work and consequently equip some of their trucks with complete cutting outfits. On the other hand many steel coaches on railroad trains are equipped only with the old fashioned wood saw, ax, crow bar and sledge hammer for use in case of accident. Such equipment of course, gives the timid old lady who is deceived by the metal wood finish of the steel coach a sense of perfect security. But the passenger who knows he is riding in a steel coach will look at such equipment and only hope that his life will not depend on the efficiency of such tools in cutting through the steel work.

Another recent report of the usefulness of oxygen in rescue work was that of the Cleveland Clinic disaster, when one doctor commanded "Bring Oxygen" as soon as he arrived on the scene and it was estimated that between 5,000 and 6,000 commercial cylinders were used. Finally, as this issue is being prepared for printing, the Chicago newspapers are describing the splendid attempts of a group of firemen to save the life of a baby pneumonia victim by the use of oxygen. One account of this case speaks of oxygen being called for "as a last resort."

If it actually has the power of overcoming this disease, why should it be used as a last resort and why should it be necessary to call the fire department? This question is not intended at the least on the men of that department. It is easy for a normal human being to understand their willing devotion to such a task and there have been a number of newspaper accounts of splendid work they have done in similar cases. It would seem however, that the Health Departments, the hospitals, and doctors themselves should be equipped with the necessary devices for administrating oxygen when it is necessary and should be fully informed as to the nearest source of supply of the gas. There are very few communities where a plentiful supply is not available always at an instant's notice so that there is no great need for carrying a stock of cylinders on hand. The technique for adminstrating oxygen is so simple that it can be used without any special training. Pneumonia is a much dreaded disease and oxygen has proven the very effective method of treating it. Everyone who handles oxygen should remember this, as there is no telling when the knowledge may mean the saving of a valued life and the health departments and hospitals in general seem to be very deliberate in equipping themselves to use this method, so deliberate in fact that in a number of cases the fire department has been called to do what is really their work.

The Right Man for the Right Job

THE proposal to draft a series of personal testing programs to furnish a systematic means of determining the qualifications of welding operators for different classes of work, which was discussed in considerable detail at the recent annual meeting of the American Welding Society is another important step forward in assuring better control over welding operations. Recent years have seen a great deal of work done to improve educational activities in the welding industry. Welding schools have improved their methods and programs of teaching and welding departments of large corporations have learned by experience that they profit considerably by giving careful attention to the training of their own operators. However, the whole employment problem cannot be solved by establishing welding courses and training new men. There are many thousands of welders in the country whose experience ranges all the way from a few months to 15 or 20 years. Among these are a great many first class operators. Some of these have a good general knowledge of welding and others are experienced in only a single type of welding operation. The employer can draw on this huge supply of trained men and secure the kind of men who can do his class of welding if he has some definite method of examination by which he can qualify men to do his work. If these qualification tests are developed to cover a big variety of welding operations the welders themselves will derive a lot of benefit, as their employment conditions will become more stabilized and their individual capacities will be rated on a more scientific and systematic basis.

"Uncertainties" of Riveting

A STOCK argument used by those who would discredit welding in favor of riveting is that one can never be certain as to the actual strength of the metal in a weld, while the exact strength of a rivet is known, and—well, there it is, you can see that it holds. This argument is well nigh annihilated by a set of "don'ts" regarding riveting recently issued to structural steel fabricators. Some of these "dont's" aim to prevent weakening of the metal of the rivet, or reduction of its effective cross section, or loose rivets, caused by improper heating or by driving at temperatures outside a certain range. In other words, steel in a rivet or steel in a weld is subject to the same molecular or granular changes at any given temperature, or during the same rate of heating or cooling. There is the same necessity for rigid adherence to an established procedure, for employing only trained and experienced workmen, and for allowing a safety factor in designing joints. The same reasonable precautions that have made the riveted structure an undeniable success, in spite of the human element and the natural forces that have to be reckoned with, will guarantee still greater success to the modern welded structure—greater because of the inherent advantages of welding, such as the saving in dead load, and usually in cost, and the greater flexibility in design. Consideration of a few scientific facts will show how imaginary is that bugaboo of the "uncertainties" of welding as compared with riveting.

Business as Usual

BUSINESS this year is ahead of 1928, according to the survey of conditions just completed by the National Conference of Business Paper Editors. This report reflects the opinions of one hundred and fifty-two editors of business papers, practically all of them leaders in their respective fields. Their intimate contacts with conditions reveal that high money rates, tariff legislation and labor problems are not hampering trade or industry, both of which continue to make constructive progress. In iron and steel, in the automotive production field, in the chemical industries and in building, fields of particular interest to the welding fraternity, business looks good for some time to come. Altogether it looks like a good year.

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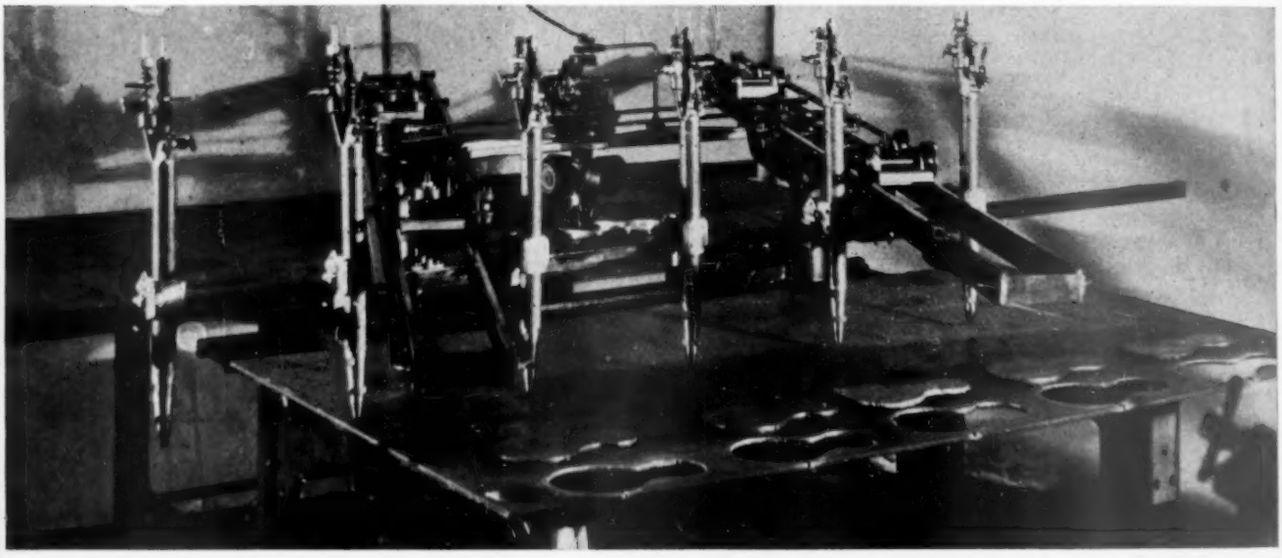

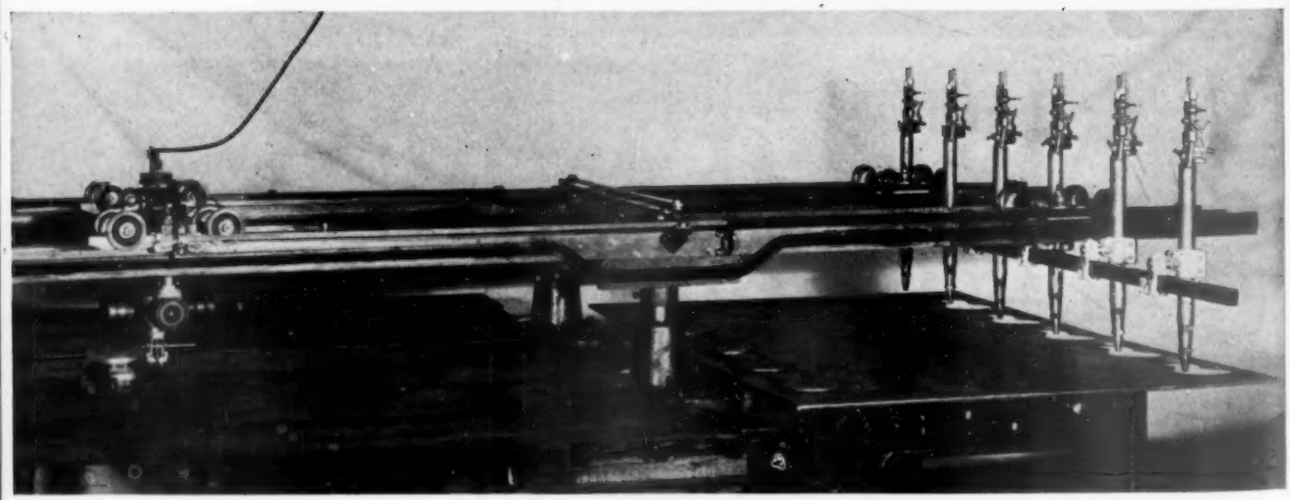

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Welded Machine Tool Structures

Some Striking Examples of Variety of Machine Parts Which May Be Fabricated Economically of Welded Steel

By J. R. Weaver*

UP UNTIL the present time, the progress made in the building of machine tools of welded design has been rather slow. This, however, is due largely to the fact that machine tool manufacturers and users have not realized the many advantages afforded by welded designs over the cast tools. This new field of application of the electric arc should, within a short time, extend far into the machine tool industry.

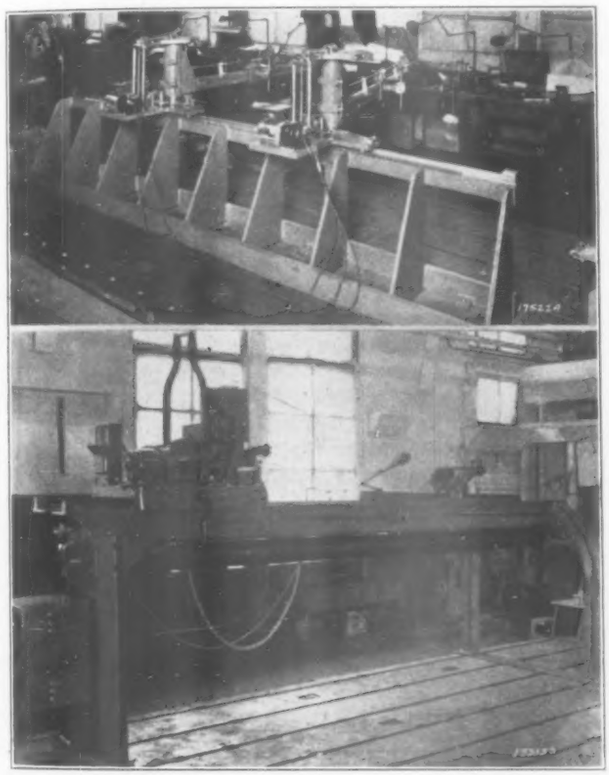


Fig. 1. Arc welded oxygen—acetylene machine for cutting steel plates. Fig. 2. Welded work handling tool for automatic seam welder.

Arc welding offers numerous advantages and economies in the production of the machine tools. It eliminates to a great extent the usual complicated, expensive and heavy casting now used in machine tool construction. Such large and bulky patterns can be scrapped and their storage space may be utilized for manufacturing operations. The new design presents a much more favorable appearance than the former.

In the application of welding to machine tool parts, certain limitations exist, but in general it can be used in a large number of cases. Usually, one glance at any machine tool of cast construction is sufficient to note the possibilities of substituting a welded design.

The base structures and component parts of machine tools such as lathes, boring mills, drill presses, planers, shapers, punch presses, etc., can be made from rolled steel plates and standard H and I-beam sections, cut to shape and welded together by the electric arc. This method of tool manufacture permits unusual flexibility in design, in that all work can be done from sketches and drawings which give the cutter and welder complete information on the job. Drawing room time is also materially reduced, due to the simplicity of such designs.

The structure shown in Figure 1 offers a good illustration of arc welded design and construction. This tool is a mechanically operated oxy-acetylene cutting machine for steel plate fabrication. The torches may be easily moved to any position within the radius of the swinging arms so as to accommodate even the most complicated designs to be cut from the steel plate with this tool. This tool structure was built up of steel parts, according to simple specifications and drawings.

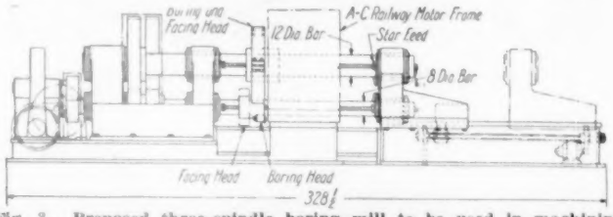


Fig. 3. Proposed three-spindle boring mill to be used in machining railway motor frames. Arc welding to save 50% on cast design costs. (Drawing)

In many instances the users of machine tools find that it is impossible to purchase certain special tools on the open market without incurring considerable expense and development charges, as well as being subject to unusually long delivery dates. These disadvantages are to be expected, especially where new patterns and castings would be necessary.

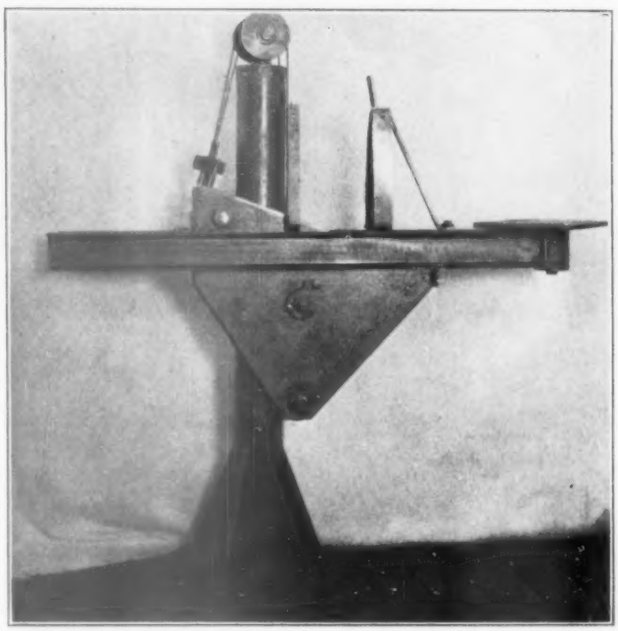


Fig. 4. Swing arm pedestal consisting of small I-beam sections, rolled plate and pipe material—all arc welded. Note the compact appearance and flexibility of design.

It is often possible to construct such tools by making their base structures and many of their component parts from stock steel parts welded together. The result in so doing is prompt delivery of made-to-order tools with lessened costs.

The work handling tool shown in Figure 2 is of special design, intended for the support of an automatic welding head mounted on

*Supt., Manufacturing Equipment, Works Dept., Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa.

a travel carriage and for the accommodation of material used in the welding of tank and pipe longitudinal seams. Such a tool is readily constructed from I-beam and H-beam sections and rolled plate stock—fabricated and arc welded.

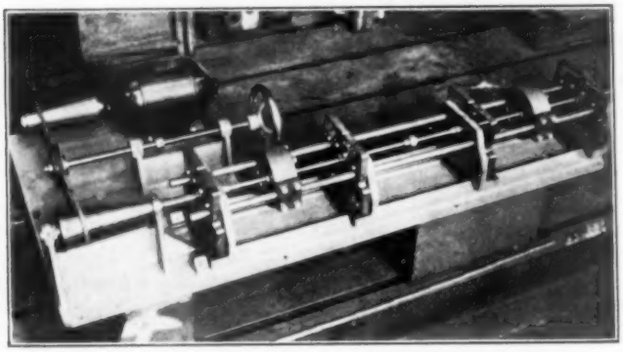


Fig. 5. Dynamic turbo-generator model for experimental purposes. Base structures are built entirely of welded steel parts.

Note the special three spindle boring mill of arc welded design shown in the drawing of Figure 3. This is to be used in boring electric railway motor frames. It was computed that approximately 50 per cent savings in cost would be made by constructing this mill from welded structural steel parts rather than by having it built from castings using special patterns. A proportional savings in weight would also be effected by the welding.

Other illustrations shown are typical of special shop tools which

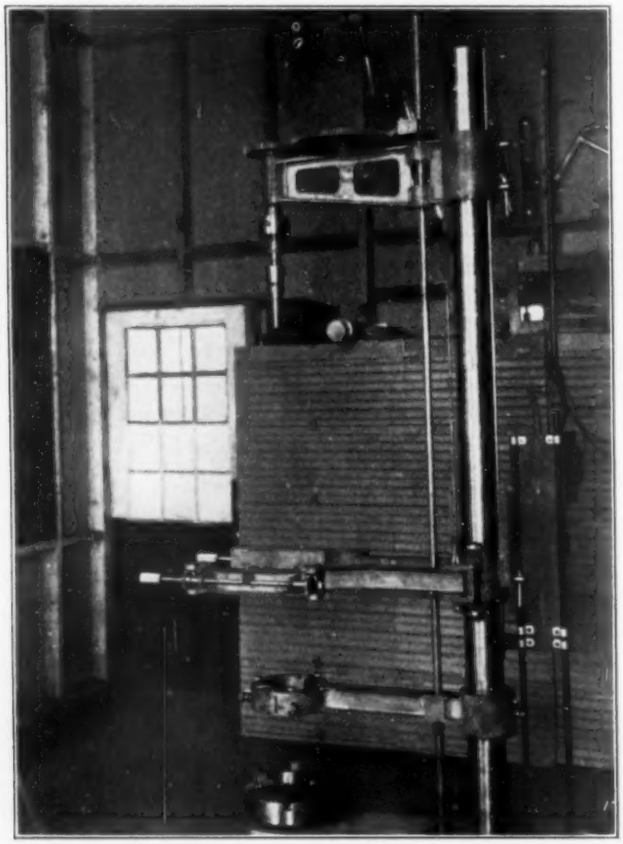


Fig. 6. Welded jig used in the manufacture of radio power tubes. This is suggestive of the application of arc welding to drills, presses and many other uses similar to that here illustrated.

can readily be made from structural steel parts. The wide variety of shapes and general appearance of these structures are noteworthy. Usually welded designs differ in appearance from the equivalent cast design. However, in effecting the transition from a cast to a welded steel design, it is desirable to avoid copying the physical form of the cast construction because the greatest advantages of welding are obtained when the structure is made to fulfill its service requirements without regard to its general appearance.

As in the case of welded bedplates and machinery parts, it is only a matter of time before the trade will become accustomed to seeing welded tool structures.

Actual practice of this method of tool manufacture has proved that it is of great value to the user; because of its great possibilities, it deserves the interest and investigation of all modern manufacturing concerns.

EMPHASIZES THAT WELDING IS A SPECIALIZED SERVICE

That welding departments in authorized service stations and fleets in large cities are unprofitable without a quantity output, is claimed by Charles Michaels, President of Michaels & Mourre, welding specialists with plants in New York City and Long Island City, in the May issue of the service bulletin issued by the Automotive service Association of New York. He has particularly in mind the application to work in both authorized service stations and the service stations of privately owned fleets of busses, taxi cabs, and trucks in the New York Metropolitan district. He points out that the apparent simplicity of the oxy-acetylene torch and the low cost of the welding outfit itself makes it look like a real small investment. When, however, he calls attention to the fact that welding operations require a certain amount of space and that the rent on this space should be figured in with the cost on a yearly basis, together with all of the equipment which is necessary in addition to the welding outfit. He figures the gas cost at $4.00 a day and additional materials at $5.00 a day, wages at $1.00 per hour and does not forget to add 100 per cent for overhead. On this basis he estimates that to operate the welding department profitably there should be a monthly volume of business of nearly $600.00. His recommendation is that where the volume of welding does not approach this figure the work should be turned over to a welding specialist. Particular emphasis is placed on the difficulty of securing welders who will do creditable work. He points out that the welding specialist knows how to hire the right kind of men, whereas the service station manager, not being familiar with the process, is quite apt to make mistakes in selecting operators.

"There is only one reason that will justify a welding department in a service station," says Mr. Michaels, "and that is a volume large enough to employ at least three men so that every job is handled by the man best fitted. One of these men should be a working foreman at $65.00 per week to do the frame and axle work; the other two at $50.00 a week each will work on cast iron, aluminum, bronze and some monel jobs. You must have enough volume to give these men steady work the year round. You can't lay off a good welder and hire another one just as good the next day."

Mr. Michaels recommends that wherever a one-man welding department is operated in a large city careful costs should be kept to determine whether the welding is done economically or could be done at lower cost by sending it out to an expert job welder.

A. O. SMITH BOOKLET DESCRIBES ARC WELDED PIPE AND PIPE JOINTS

A 50-page booklet, interestingly illustrated, which tells of the development of their automatic electric arc welding process of making oil and gas line pipe, has just been issued by A. O. Smith Corporation, Milwaukee, manufacturers of various types of special, bell and spigot, and expansion joints, as well as pipe of diameters ranging from 8⅝ to 26 inches. The specially designed pipe mills which form and weld up to 26 miles of 30- and 40-foot lengths of pipe per day are described and illustrated, as well as the testing, handling, finishing and shipping operations.

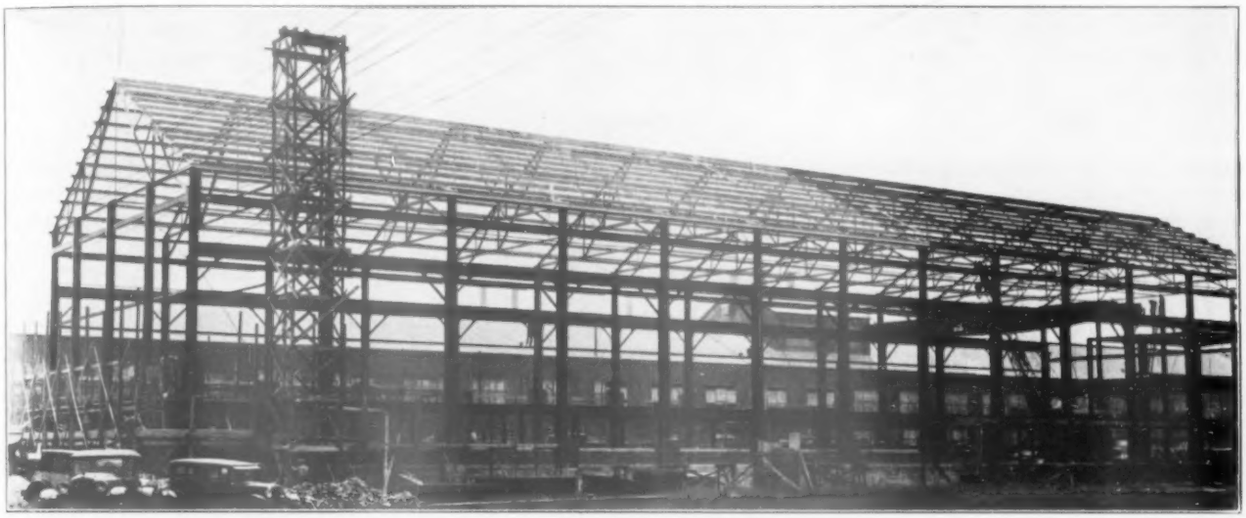
Among the advantages claimed for "Smithwelded" pipe, is that of weldability, not only the composition of the steel but the mechanical advantages, such as absolute roundness and straightness, lending itself readily to welding in the field.

Gas Welding a Steel Building*

Construction Details of Structure Welded for Union Carbide & Carbon Research Laboratories, Inc., in Niagara Falls Plant of Union Carbide Company

By H. H. Moss†

THE utilization of gas welding in place of riveting in the construction of the steel framing for a building being erected by Union Carbide & Carbon Research Laboratories, Inc., in the plant of the Union Carbide Company at Niagara Falls, marks a stage in the development of structural welding by the oxy-acetylene process, wherein this method advances to embrace the major industrial structure. As far as we know, this is the largest structural building frame that has been so constructed, and the first of its character to be fabricated and erected under usual procedures of construction.



Gas Welded Structural Steel Frame of the Union Carbide and Carbon Research Laboratories Building.

Description of Building

The building is a Mill type having a single aisle 75 feet wide between column centers, by 260 feet long, arranged in thirteen 20 foot bays, by approximately 42 feet and 5 inches to the lower chord of trusses. Mezzanine operating floors extend along the entire westerly side of building, single stage in bays 1 to 11 and three stage in bays 12 and 13. These floors are 27 feet wide and 11 feet, 9 feet and 6 inches and 9 feet and 6 inches in vertical elevation. The main and first mezzanine floors are served by a full span, 10 ton capacity traveling crane. A standard gauge railroad siding enters the building through car-doors provided in the south end, to facilitate handling of equipment and operating materials.

The side envelope is of common brick and steel sash of approximately 50 per cent wall space ratio. The roofing is No. 18 gauge galvanized corrugated copper bearing steel supported by 8 inch channel purlins.

Connections in the north bend provide for future building extension. This was taken care of by a dual arrangement in the design of the splice plates on the lower chord of the end truss and by welded details provided with assembly bolt holes otherwise. Six 60 in. diameter galvanized ventilators will be mounted along the ridge for general operating ventilation. The floor construction for the main operating floor will be a brick paving on a rammed slag fill and for the mezzanine floors of reinforced concrete with a 5 in. finished slab over beams and girders. The building is unattached, contains approximately 300 tons of steel and will be used exclusively for research purposes. Typical framing plan and transverse elevation are shown in Figs. 1 and 2.

Premise

The Niagara Falls building is the first of a series of welded building structures in contemplation for construction under the direction of the Development Section of The Linde Air Products Company. This type of building was selected for the initial project primarily because it contained a miscellany of structural joints, and offered opportunity for a more general application of structural welding than would have obtained in the pure multistory type of structure. In execution, it would provide structural welding data for a number of industrial types of building structures.

Although from a gas welding standpoint, this building is in the class of experimental cases wherein the time factor is nearly always of secondary importance, urgent need on the part of our research organization for the finished building, demanded prompt execution of all construction phases of the job. The delivery of fabricated steel to the site was desired within twelve (12) weeks, and erection not more than four (4) weeks after delivery. General plans of the building, including typical framing had been prepared by Union Carbide Co. Engineering Department, but as the framing was designed for riveted construction, a re-study of the framing designs was necessary before the job could be placed in the hands of shop draftsmen for detailing. A delay to permit of this and preliminary arrangements was obvious and an extra months' time was granted by the research company.

Decision on the part of the management to handle the welded steel in a manner similar to that which would have been followed, if riveted, had a dual objective.

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*Paper read at the Inspection Party held at Niagara Falls, June 19, 1929.

†Development Section, Engineering Department, The Linde Air Products Co.

1st.—Provision of proper construction facility and consequent maximum speed of construction.

2nd.—To obtain practical experience with gas welding when applied to this class of building structure under conditions having a semblance of routine production and erection character.

It was recognized, however, that the cost for this first case would probably be higher than that for a riveted job, as there had been no previous opportunity for fabricators or erectors to develop experience with this method of structural welding, therefore promising a period at the beginning of shop operation and field erection, subject to a certain amount of experimentation and modification of methods, and during which the welding rate would not be up to production speeds. It was further decided that the job be manned by welders at large, rather than by the company's trained operators, thus providing an opportunity to determine the feasibility of employing the welder at large for work of this kind.

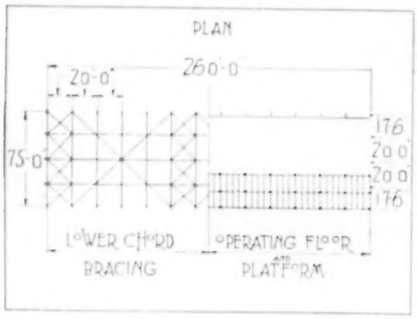


Fig. 1

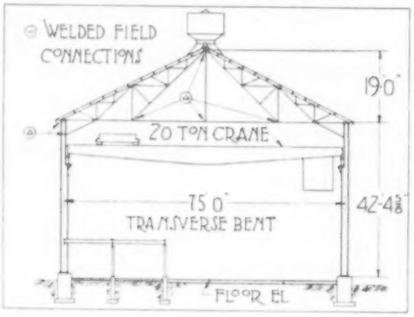


Fig. 2

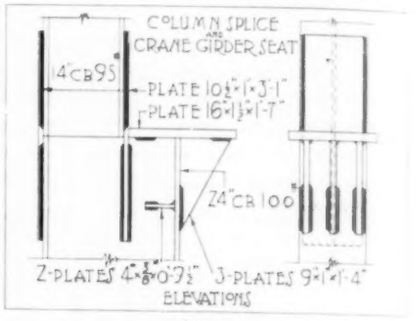


Fig. 3

The structural welding facilities of the Trenton, N. J. Shops of the American Bridge Company were available and forthwith prepared for this job.

Design

In general, the designs for welding developed for this job, were characteristic of the lap method of assembly of parts, utilizing the fillet type of weld. This is particularly true for the truss web members and for beams and girder connection details. Exceptions to this method were made at the heel and ridge joints of the trusses where a combination of fillet and butt welding was utilized and in the anchorage details for all principal columns. Liberal use was made of the C. B. beam and column sections. Through the elimination of built-up columns and girts commonly used in this type of building by utilizing rolled single sections and by placing bolt holes for assembly purposes in details, wherever possible, the major tonnage had only to be gas cut or milled prior to transfer to the welding skids for either jigging and for the attachment of details. As the roof purlins and chord bracing would ordinarily not be riveted in place, welding of this material was therefore omitted.

The main building columns were composed of two milled C. B. Sections, one 24"x12"x7/16"x100'# and one 14½"x12"-x1/2"x95#, offset at the elevation of the crane beam seat. These sections were shop spliced by fillet welding 1"x10½"-x3' 1" plates on the face of column flanges, the inner plate being cut to straddle the web of the 24 C.B. section below the web joint as shown in Fig. 3. The base plates for these and end columns were delivered to the job with necessary anchor bolt holes ahead of framing, so they could be set and grouted before the columns arrived. Anchorage for the columns was effected by means of double extra heavy pipe lugs,

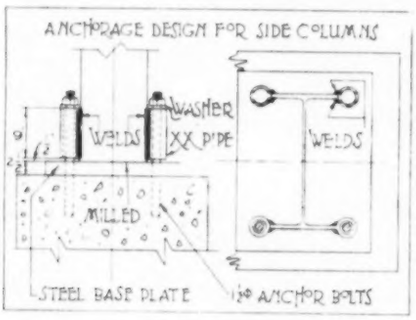


Fig. 4

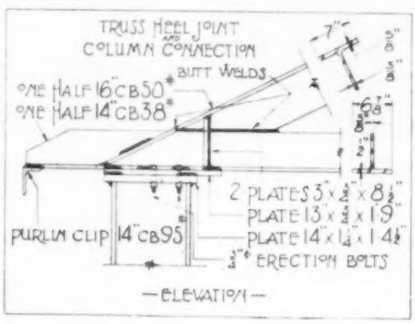


Fig. 5

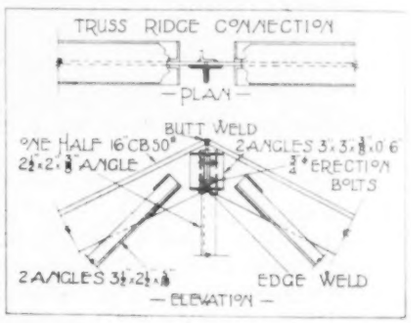
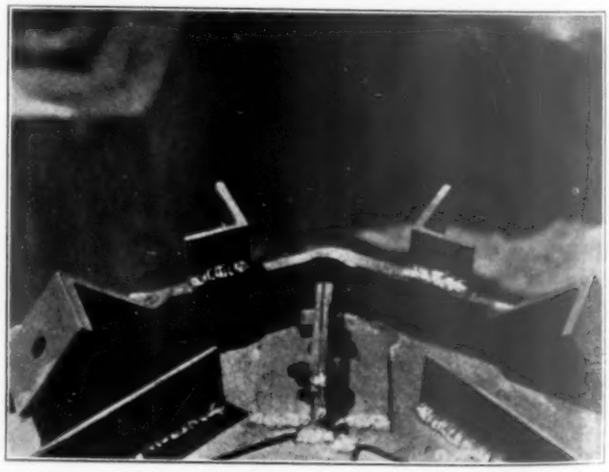


Fig. 6



Detail of Peak of Truss

double fillet welded to the edges of the column flanges, through which the anchor bolts were passed and secured by the nuts, as shown in Fig. 4. One-half inch round washers were used to seat the nuts to the upper milled edge of the lugs. The columns are capped by suitable bearing plates fillet welded thereto along the outer face of flanges only, Fig. 5. In these plates bolt holes were provided for field assembly with corresponding holes in bearing plates welded to the under section of bottom chord of truss.

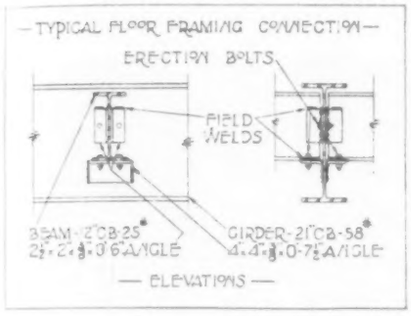


Fig. 7

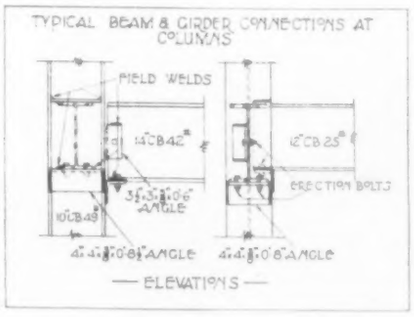


Fig. 8

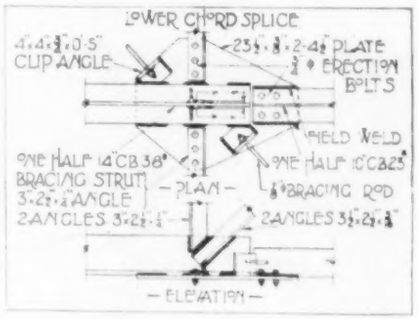


Fig. 9

The connecting details on columns for girts, lintels and beams were made up of clip angles providing landing seats and side connections where necessary. These details provided with assembly bolt holes, were welded to the columns, thus avoiding shop work other than milling and welding on the column sections. In some cases a plate was welded to the top flanges of the member, wide enough to fit inside of column flanges, the clearance distance being mode up by a field weld laid against but unfused to column flanges.

The configuration of the trusses, which are 75' 0"x19' 0", is a modified compound Fink of 1/4 pitch having the principal compression struts, normal to the lower chord. This permitted the welding of trusses in half sections in the shop as the modification brought the dimensions of the sections within shipping limits.

These trusses are designed to sustain, in addition to the dead load, a snow load of 25 lb. per sq. ft., a wind load of 15 lb. per sq. ft. applied normal to the top chord, and three concentrated loads of 2000 lb. each at the center and the two principal joints of the lower chord, calculated as hoisting loads. The upper and lower chords were developed from 16" C.B. 50# and 14" C.B. 38# sections by splitting them longitudinally. This produced T-sections with sufficient leg length to receive the web members without using gusset plates. Where these T-sections meet at the heel of truss, Fig. 5, the webs were butt welded (in shop) and at the ridge, Fig. 6, the flanges were butt welded (in field). At the heel, the upper chord flange was extended to engage the flange of the lower chord. The web and knee-brace members are composed of angles permanently secured by ⅜-inch fillet welds. Typical connection details for the mezzanine floor steel are shown in Figs. 7 and 8.

For the floor beams use was made, wherever possible, of the flat flanges of the C.B. section for landings, welded connection details being provided for beam webs only. In designing the connection for beam and girders, 25% was added to present floor loads to provide for possible future load increases to this amount. In addition to these allowances, an increase of 100% has been made to the present crane loads, permitting the installation of a 20 ton capacity traveling crane on the present crane way.

A unit stress of 16,000 lb. per sq. in. governs for base metal design and for weld metal design 11,300 lb. per sq. in. for shear and 15,000 lb. per sq. in. for compression through the net throat of fillet and butt welds. All welding was done with Oxweld No. 1 High Test welding rod, which produces weld metal having 58,000 lb. to 68,000 lb. per sq. in. ultimate tensile strength, a yield point of 40,000 to 42,000 lb. and an average elongation of approximately 25% when determined by the Miller Bend Test.

Shop Fabrication

From a fabricating standpoint, the job progressed with good dispatch. At the outset, the rate of production was somewhat slow due to welders' unfamiliarity with this class of work, but after the first few members and assemblies were welded, the welding rate per hour increased steadily and little difficulty was experienced from then on in maintaining alignment. Each welder was required to pass qualifying tests as recommended by the American Welding Society Code, and by competent inspection, the quality of the shop welding was kept to a high average. In not all cases were we able to obtain smooth looking welds, but as the job progressed this detail was improved with resultant improved economy.

Welding Peak of Truss.

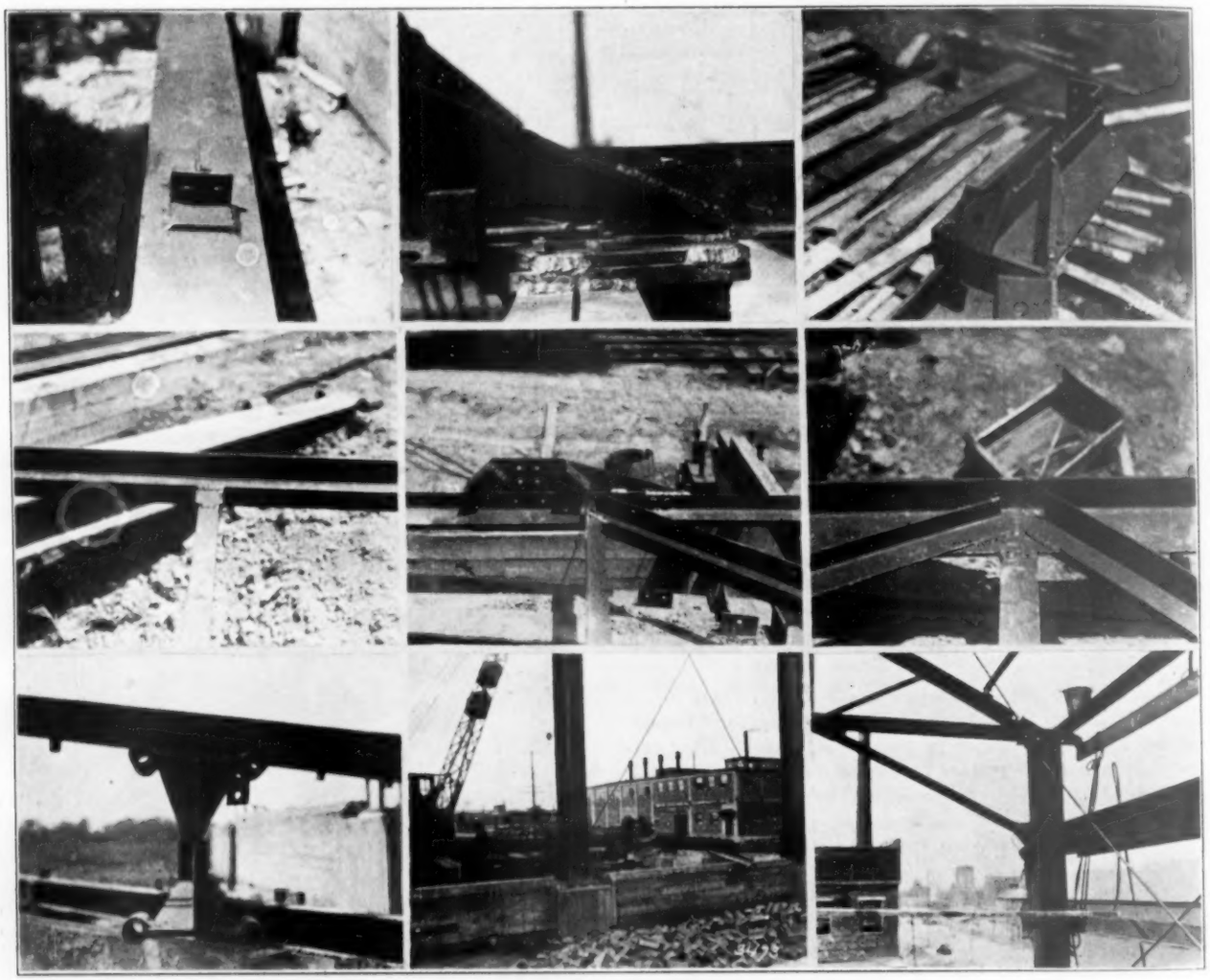
The trusses were assembled in jigs secured to the welding skids in which the truss members were clamped for welding. Simple clamps were developed by the Bridge Company for the shop assembly of details. For this job oxygen and acetylene were supplied from groups of manifolded cylinders placed at convenient points in the welding shop.

The shop welding was started on April 1st and completed about May 15th. In all ten welders were employed, starting with two the first week, four the second week, six the third week and an average of nine thereafter until completion.

Erection

The erection contract calling for bolt assembly only was awarded to Mr. George C. Holcombe of Buffalo and Forestville, N. Y.

The field welding is being carried on as a separate job under the local construction organization of Union Carbide Company and under the supervision of the Development Section of the Linde Company. Three of the shop welders were brought here to do the field welding for the purpose of completing their experience. Our first field welding consisted of joining the half truss sections on the ground. Bolts at the splice and ridge joints Figs. 9 and 6, permitted bolt assembly of these sections, which was done by the erector. The assembled trusses were laid flat on blocking along one side of the main aisle, each truss lapping the other in such a manner so that the welders could get at the joints. This procedure required one-half of the welding on these trusses to be done overhead, and demonstrated the feasibility of joining welded trusses in the field in a manner similar to that if the joints had been riveted.



Views of Typical Details of Structural Connections.

About Cost

During the period of shop fabrication our observers made time studies of the rate of welding developed by different welders. At the beginning of the job, the average number of inches produced per day of 9 hours was in the neighborhood of 180 inches for the specified ⅜" fillet welds and 135 inches for the ⅝" fillet welds. As the welders became more familiar with the production sequence and had opportunity to improve their skill in the production of specification welds, these averages increased to 320 inches per day for the specified ⅜" fillets and 245 inches per day for the ⅝" fillets.

The term "specified ⅜" fillets" is used because in reality they were larger, it being difficult for the welders to hold to the small dimensions of the ⅜" weld on this class of material. Therefore an adjustment is necessary in our calculations on rates in order to give consistent information.

The total theoretical amount of welding taken from the drawings is as follows:

⅜" Fillet Welds	2483 ft.
⅝" Fillet Welds	334 ft.
⅜" Open Butt Welds	69 ft.
⅝" Single Vee Butt Welds	35 ft.

On the basis of the rates of welding prevailing during the latter period of shop fabrication, which approached production speeds, the total number of man hours would have been between 1300 and 1400. In reality the man hours actually consumed were about double these figures, the difference representing lost motion, time spent in developing the welding crew, and in trying different methods of shop procedure.

Had we taken advantage of the average over size obtained in the specified standard fillet welds and utilized the excess strength developed thereby in our weld design, the theoretical amount of standard fillet welding just quoted would have been reduced approximately 20%. On the other hand had all advantages which this experience developed been taken into account, it is estimated that around 1100 man hours of welding would do all the necessary shop welding.

By another division, we can get the expected average tonnage per welder per day. This figures about 1.67 tons per day of 9 hours, for the material upon which welding is performed. For this job, the amount of material upon which shop welding was performed is approximately 203 net tons, or about two-thirds of the total tonnage, the balance of 94½ tons requiring either field welding or field bolting only.

The shop gas consumption can be readily estimated by multiplying the net blowpipe hours by the gas rate per hour of the different sizes of welding tips used. For a hypothetical production case it is estimated that between 200 to 225 cu. ft. of oxygen and 185 to 208 cu. ft. of acetylene would be consumed per average ton of shop welded steel.

General View of the Building During Erection.

Welding Rod consumption can also be readily estimated from the footage weight for different sizes and types of welds. For ½" fillet welds, which we can assume to be the minimum standard for gas welding on this class of structure, the rod required is approximately 0.6 lb. per lineal foot of weld. For the 5/8" fillets 0.85 lb., for the 3/8" open butt weld 0.5 lb., and for the 5/8" single vee butt weld 2.2 lb. These figures include allowance for over size and a slight rod loss. From these figures we can calculate approximately 7.5 to 8 lb. of welding rod per average ton of shop welded steel.

From the above data, it has been estimated that the shop welding cost should average not more than $20.00 per net ton of shop welded steel, or $13.70 per ton on the basis of total job tonnage, exclusive of the cost of milling, splitting, shearing or cutting, punching and handling expense. The above figure is based on a welder's rate of $1.00 per hour, includes all setting-up expense in the welding department, and an 85% overhead on labor.

This cost will be offset by an amount representing the erected cost of the steel saved by welding as against riveting. The saving in weight on a job of this character is at least 10% of the weight of a similar riveted structure. For the case in question, the saving amounts to approximately 66⅔% of the shop welding costs, bringing the net shop cost for welded construction within commercial ranges.

As more experience is gained in this work further economies will be obtained. These will come through greater utilization of the strength provided by welded construction improved designs for connections, lower detailing expense, more efficient handling of welding equipment throughout the shop, standardization of set-up for welding, and by increased production rates of welding.

It is expected that the field erection cost for a welded structure of this type will be about the same as for riveted construction. For the pure multi-story type a lower cost will probably be realized.

Accurate study of the field cost is being made for this job which will permit us to advise definitely on this point as soon as the work is completed.

Complete delivery of steel to the job was made by June 1st and it is expected that all field work will be completed, as far as the framing is concerned, by July 6th, thus indicating a completion within twenty-three (23) weeks from the date of the contract with the fabricator.

ARC WELDING PLAYS IMPORTANT ROLE IN 1929 LIGHTNING STUDIES

Although many diverse applications have been found for arc welding, the tall, slender device shown in Figure 1 is a particularly interesting scientific instrument in which the welding process has played an important part. This instrument, which might easily be mistaken for an anti-aircraft gun, is an improved type of Norinder-Du Four cathode-ray oscillograph being used by the Westinghouse Engineers this summer in an extensive campaign of lightning investigation. The oscillograph is encased in an air-tight housing made up of welded plates and tubes. All insulating bushings are made of specially prepared porcelain soldered directly to the steel shell to minimize the usual difficulties with securing of a proper vacuum.

Arc-welded oscillographs similar to the one shown in photo are installed in field laboratories at the following locations:

The Housing of This Oscillograph Is of Welded Steel.

1. Stillwater, New Jersey—Public Service Electric and Gas Co., 132 kv. line.
2. Charleston, W. Va.—American Gas & Electric Company, 132 kv. line.
3. Frankfort, Ill.—Public Service Company of Northern Illinois, 132 kv. line.
4. Chota, Tenn.—Aluminum Company of America, 154 kv. line.
5. Chilhowee, Tenn.—Aluminum Co. of America, 154 kv. line.

These oscillographs are capable of recording the complete story of a lightning disturbance on a transmission line in terms of millions of volts and millionths of a second. Both manufacturer and the operating companies realize that only through securing accurate data on the behavior of lightning can definite progress be made in providing adequate protection against this greatest menace to uninterrupted power.

G. P. A. BREAKS ATTENDANCE RECORDS AT SUMMER MEETING

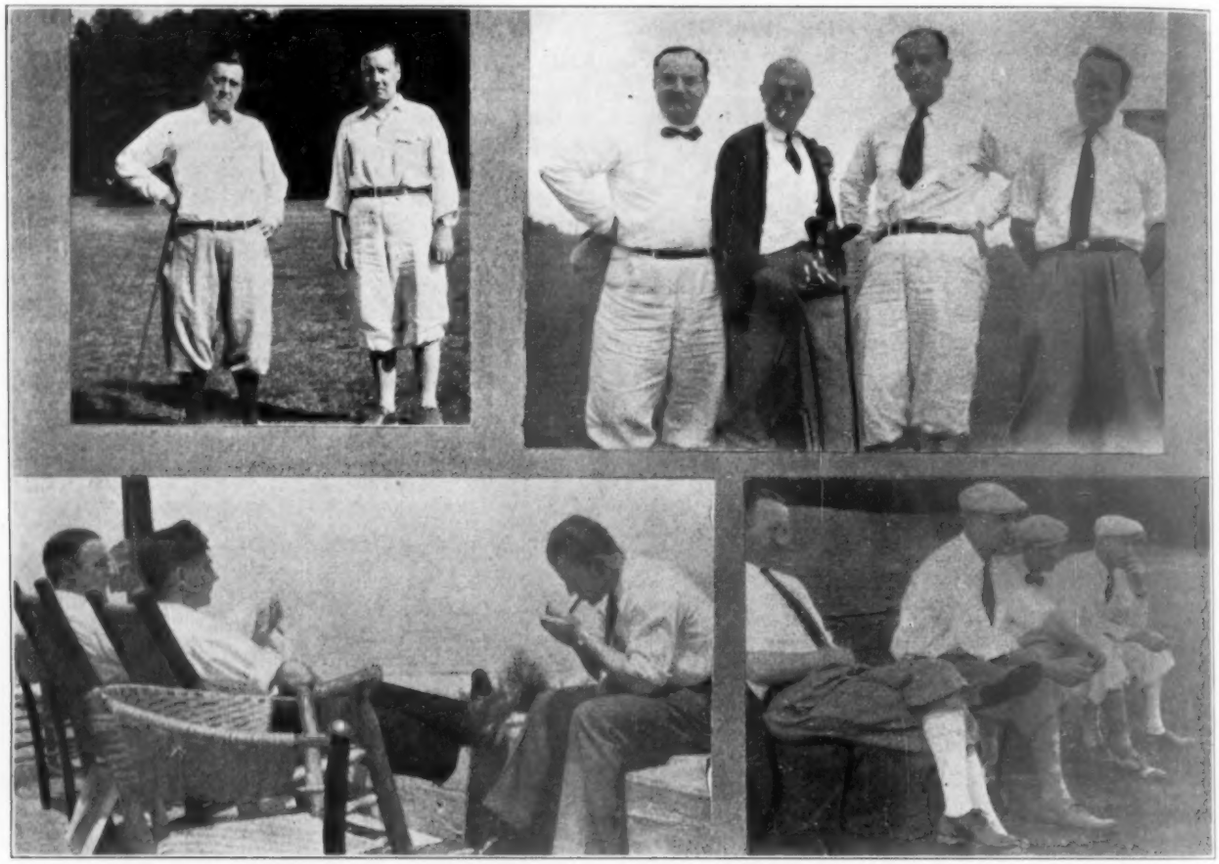
During the past month, the Gas Products Association held what is considered the most interesting and successful convention which has been staged for a number of years. This was held at Grand Beach, Mich., June 20-22. All previous records of attendance at summer meetings were broken, there being a total of seventy-eight present.

There were two outstanding features of the 1929 meeting. One of these was the splendid program of recreation and the orderly manner in which it was arranged. The other was the fine organization of the business meetings which were restricted to a limited number of topics and started so promptly on schedule that the program was not allowed to drag at any time. The facilities provided by the Golfmore Hotel, the headquarters of the convention, and which were taken advantage of to the utmost by the program committee, made it possible to hold most of the meetings in the open air.

The subjects discussed pertained mostly to the opportunities for further development of the oxy-acetylene welding and cutting process and some of the technical aspects of important applications of these processes. The recreation program was mostly golf in the daytime and bridge and dancing in the evening. A number of splendid prizes were donated by members and friends of the association for various events in the golf tournament and the bridge games.

Ideal weather conditions prevailed throughout the three days of the convention so that everybody fully enjoyed the natural recreation features which the Dune country on the shore of Lake Michigan affords. In addition to a large number of active members of the association, there were present several former members who become separated from it through mergers with other companies, but came to the meeting at Grand Beach to keep up their acquaintance with the friends which they had made through years of business association.

At the conclusion of the meeting Mr. O. E. Engler, of the Balbach Company, was elected president for the association for the ensuing year and Mr. M. L. Goodrich was elected secretary and treasurer.



Poses, Formal and Informal, Picturing the Contentment and Good Fellowship Which Prevailed at the G. P. A. Meeting.

THE EXAMINATION OF WELDS, CASTINGS AND METAL OBJECTS BY X-RAY

X-ray photography is practically identical in the public mind with certain phases of medical and dental science. But such a valuable tool would not readily confine itself to the needs of the anatomical sciences in this day of alertness to new uses for existing processes. X-rays are increasingly being used to determine the internal structure of inanimate objects.

Steel castings, aluminum castings, welds, metal radio transmission tubes, a variety of other metal objects, and even trees and telegraph poles, have been subjected to x-ray examination. Such examination has already become standard practice in some factories. The principal work along these lines has been done in the Watertown Arsenal and the Massachusetts Institute of Technology in the United States, and in the Woolwich Arsenal in England.

This information, as part of a brief survey of the theory and use of X-rays in industry, is included in a booklet just prepared by the Eastman Kodak Company entitled "X-rays in Industry." The publication, which will be sent to interested persons, has the intention of suggesting some of the industrial applications of X-rays in inspecting the internal contruction of opaque materials.

One of the numerous applications described and illustrated is the inspection of welds, by which slag inclusions, blow holes, poor fusion and other defects are readily detected.

Building Reinforced Concrete Pipe

Arc Welding and Resistance Welding Both Play a Part in the Construction of the Steel Reinforcing Members

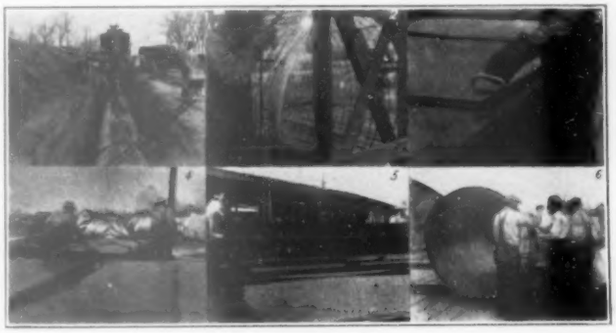
By J. C. Coyle

THE manufacture and installation of eight miles of sixty-inch reinforced concrete water pipe is no small order, as one realizes after a visit to the plant recently installed by the Lock Joint Pipe Company in order to fulfill a contract for the city of Denver, Colorado. 3,520 sections of the pipe will be required, each weighing seven tons. (Fig. 1.) The only logical method of handling the installation was to establish a plant near the site of the pipe line, and this was done. Two railroad spurs were constructed through the middle of the set-up and material was unloaded directly from the cars to the point of manufacture. A large company crane was operated on this track, for handling wet concrete, finished pipe sections, forms and steel, and for spotting cars.

A considerable part of the weight of this pipe is steel reinforcing, proportioned according to the pressure which is to be upon the inside. Two and a half miles of the line will have a low pressure, and in this pipe there is only a cage of steel hoops and a netting of Nos. 9 and 14 wire, as reinforcing, with 6 and 7 in. joint rings at the ends. (Fig. 2.) In the high pressure pipe for the rest of the line a steel cylinder, of 12 gauge, is used. Fabricating this reinforcing is a most important part of the manufactoring operations, in which electric welding plays a prominent part. Many special items of equipment have been devised, with which to meet the peculiar demands of the various manufacturing operations in the steel department.

The large sheets of steel for the cylinders are stacked one upon the other, and for moving them, as required, a special tool has been made of $\frac{5}{8}$" steel rod. (Fig. 3.) This is made into a loop of convenient size for a man's hand, and with a slightly flattened hook turned back close to the loop. This is drawn to a wedge shape at the end, so as to be easily forced between the sheets of metal. Pinched fingers are thus prevented in moving this material. The first movement of the sheets is to the punch table, a large metal bench close by. Four punches at opposite sides of the table punch the $\frac{3}{8}$" holes for riveting seams. The sheets are held off the table by an 1½" angle and a 1½" square bar at each pair of punches. (Fig. 4.)

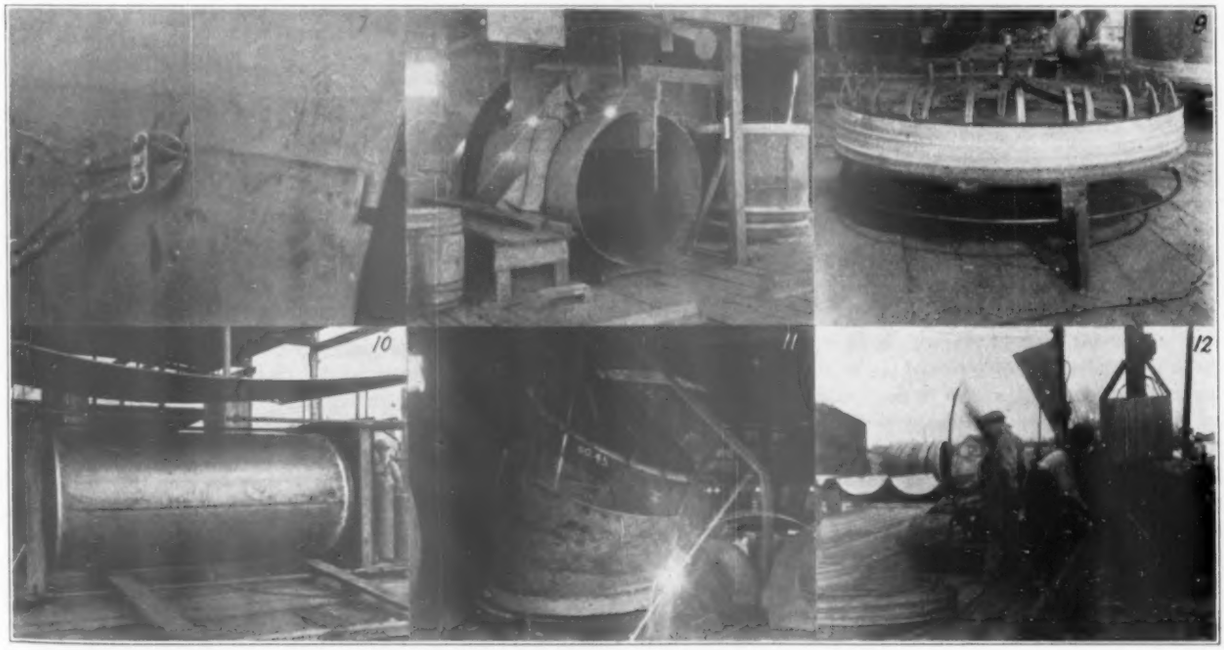
The punched sheets are then slid on to another pile, and then into the big rolls which give them the proper curve. There are three rollers (Fig. 5), the top one 7" in diameter, the others 6". They are set in boxings in a frame of two 14" channel irons, with a third channel of the same width above the top roll. The ends of the framework are of 4" by 8" angles, bolted together. The rolls are operated by an electric motor. As the sheets come from the rolls they are caught by a man at each end and land upon



Figs. 1 to 6—Preliminary Operations.

a curved former. Any irregularity of curve is then quickly removed with large wooden mallets.

An assembling crew next places three of the sheets in order about two hoops of $\frac{7}{8}$" by 2" steel (Fig. 6), which are secured, one at each end, by clamps. The edges of the sheets are temporarily joined by inserting No. 7 cut nails in the rivet holes. These nails are easy to place, even though there is a slight discrepancy in the position of the holes. A small nut is slipped over the nail, the latter is clipped off with a pair of wire cutters, and is bradded in place (Fig. 7). After the seams have been welded these nails are removed and regular brads inserted, to hold in place short strips of light steel bar against the netting of 4" wire mesh, which is applied to the inner surface of the cylinder.



Figs. 7 to 12—A Variety of Welding Is Involved.

When the temporary rivets are in place, the cylinder is rolled upon a long, low car, with two metal rollers lengthwise of the top and 4" wheels. It is then rolled into a welding clamp made of 14" channels. The top one of these is suspended from the ceiling, at the front end, by a chain and turnbuckle for proper adjustment, and has a strip of copper along the under edge, for contact (Fig. 8). The lower angle has two sections of 2" air hose attached to its upper edge, and is clamped in place by a lever and pin from the upper channel, the pin slipping into a slot in the end of the bottom channel as the lever is pulled into place. Compressed air, applied through the hose is used to hold the seam in place while welding, and is released to make room for the cylinder to be turned, or another to be placed. Near this station are the twelve Lincoln welding machines used at the plant. This number of units insures available current for scattering jobs at all times. A Gardner-Rix air compressor furnishes air.

Figs. 13 to 15—The Finished Reinforcement.

The cylinder is next picked up with a Yale block and set on end in an expanding mandrel which works upon the principle of an umbrella, several arms forcing the sectional copper rim of the mandrel against the inner surface of the cylinder end, as a screw bar in the center is operated by the large wheel beneath the mandrel. A number of curved guards on the upper edge of the mandrel aid in placing the cylinder. Joint rings are welded to the bell and spigot ends at this station. (Fig. 9.)

Metal rings, equipped with rubber gaskets are then applied to the ends of the cylinder and it is rolled into a testing jig, clamped in place with an air-jam and an air pressure of 25 pounds per square inch applied. (Fig. 10.) All welded seams are then moistened with soap suds in order to detect possible leaks. When removed from the tester the cylinder is complete.

Cylinders for elbows of different degrees are assembled by sections in a specially constructed radius assembly jig. (Fig. 11.) This jig is built up principally of angles, by belting and welding. It has a heavy metal base and the shortest radius is 5 ft., the longest 10 ft. A metal hoop, adjustable by bolting, insures correct spacing of the top section of the assembly, while a pair of light metal fins at the top of the jig gives the center of radius at that end. The different sections are bolted to the angles of the frame until all are joined by a weld every few inches along the joints. The elbow is then removed from the jig and the seams completely welded inside and out. Wire netting is applied to the inner surface and a dry mix of cement applied to build up the inner wall. Loops are welded to the outer surface of the cylinder, and it is taken to the trench and lowered into place with a crane before the outer reinforcing bands are placed. The outer wall is then built up.

The cylinders for connections are all built up by arc welding and the inside walls applied by hand, as in the elbows. Outside reinforcing bands are then welded to the cylinder by the resistance method and the connection is finished in the trench, as previously described.

From 35 to 47 reiforcing bands are used in the 12-ft. sections of straight pipe, the size and number of the bands varying according to the pressure which the pipe must stand. Four spacing bars, of ⅛" by 1¼" steel are used in each assembly of bands. (Fig. 12.) The steel bars for these bands are unloaded on a sloping rack, from the railroad cars. Sliding down this rack they are grasped by a workman and passed endwise through a set of special rolls, which turns them into hoop shape in the twinkling of an eye. These are placed inside a heavy band of metal, on a bench, and any fault in the curve at the ends is hammered out.

Near by is a cross of wood, with four metal hooks, which turns horizontally from an overhead beam. The turned bands are hung on this, one by one, and taken off by a man at the Federal resistance welding machine, where the ends are welded. (Fig. 13.) They are hung back on the hook, and as the device turns are removed by the operator of a specially devised tester which applies a pressure of 6,800 pounds to the weld of the larger bands. These are placed in a pair of clamps, which are tightened with two pressure wheels. Pressure is applied by releasing a lever attached to the upper clamp, and to the end of which a 400-pound concrete weight is attached.

The spacing bars are stacked near a special motor driven punch machine, with a long wooden horse to support the bars. At each side of the horse is a metal bar, with notches for spacing the holes in the bars as they are fed into the punch. The bands and spacing bars are joined with wire, in a special assembly cage, made of 3" by 4" by ⅜" angles, joined by similar cross angles at each end, and suspended in a frame so as to revolve as the work progresses (Fig. 14). One of the spacing angles fits into a slot in each end of the frame and is held in place by a pin. It is also attached to a small cable and pulley at each end. When an assembly is finished the pins are removed, the loose angle rises, and the finished assembly rolls out. Four ⅝" rods are applied between the space bars, and welded to the joint rings, as are the ends of the space bars. For low pressure pipe only the wire netting and bands are used for reinforcing, the joint rings being welded in at the ends of the netting, to the space bars and rods. A special jig of wood is used for this welding operation.

The finished reinforcing (Fig. 15) is rolled onto a low flat car and moved within reach of the crane, which places the assemblies in position for pouring, where the outer and inner metal forms are clamped into place, and special heads, with a three-inch circular opening for admission of concrete, lifted into place. The concrete mix is transported from a battery of four ½-yard mixers, driven by one motor line shaft, in 1½-yard, cone-shaped buckets, by the yard derrick (American Hoist & Derrick Company, railroad type). Base rings, used at the bottom of the forms, and the forms and heads as well, are well oiled.

Cement is unloaded from railroad cars to a shed over the mixers on a dolly-car holding fifty sacks, and drawn by a 10 hp. motor. An extension track is placed into the car doorway. Special wheelbarrows are used to measure the aggregates, part of the sand being previously ground in a McFarland Eggers mill, to reduce it to the proper size. Three sacks of cement are used to a batch, being dumped into a canvas spout from the cement room, upon a signal from the mixer man. A sloping metal covered chute drains the mix from all four machines into the conical bucket, which is dropped into a sump hole for loading.

The pipes are poured in groups of 30 (a day's work), closed in with adjustable forms, covered with tarpaulin, and steam cured for one day, after which the forms are taken off and the curing continued two days longer. The pipes are then rolled upon the storage yard where they cure ten days longer. 5½ inches of concrete is in the wall of the pipe, 1¾ inches inside the reinforcing and 3¾ inches on the outside, with the reinforcing bands one inch from the surface. Eight ¼" by 1" by 12" bars, welded to the joint ring and extending along the surface of the steel cylinders, reinforce the spigot ends of the pipe.

A trench, excavated along each side of the storage yard, put the trucks on a level with the skids for loading the pipes. The excavation of the trench was made with a Northwest pull shovel.

In places where rock was encountered some blasting was necessary, and Ingersoll-Rand diggers and portable compressor were

constantly employed on the job, the rock loosened by the diggers being removed in a wooden skip.

Lead gaskets, with cotton fibre core (the cotton inserted, the gasket rolled and cut with special equipment on the grounds) are painted with graphite and placed in the joints as the pipe is laid, between the spigot end of one section and the steel bell ring of the other. After compressing the joint, the gaskets are caulked and later, after settling of backfill has taken place, they are caulked again from the inside. The small space in the outside of the joint is grouted and wrapped in tar paper.

The installation was made under the supervision of D. D. Gross, chief engineer of the water department, and H. R. Oliver, engineer in charge of construction. W. W. Trickey was general superintendent of manufacture and installation for the contractors (Lock Joint Pipe Company), W. R. Abbot was supervisor of welding and J. A. Tapley pipe foreman.

ARC WELDED STEEL MOTOR BOATS

By John Van Horne

Field Engineer, The Lincoln Electric Company, Cleveland, Ohio

The Corps of Engineers, U. S. A., are now building a fleet of three arc welded steel motor boats for use as carriers and tow boats on the Mississippi River and its tributaries. This is the second fleet to be so constructed by the U. S. Engineers. The first fleet of seven was launched over a year ago and have been in continuous service ever since.

The launches are constructed entirely of steel, all permanent connections being made by the electric arc welding process. The overall length of each craft is 28 feet; the breadth 7 feet; and the depth 2 feet 4½ inches; the freeboard, of course, varies with the load, the draught being very little when the boat is not loaded. The boats have flat bottoms, slightly stepped closed to the stern and have a rather sharp rise at bow effecting a broad, flat prow, similar to the seaplane type.

Some idea of the construction of these boats may be gained from the accompanying illustrations. Figure 1 shows the partially completed steel skeleton of a hull. Each rib is made from one piece of channel iron, 1½ inch x 5/16 inch x ¼ inch, with exception of frame at rear end of forward bulkhead which is of 1½-inch x 1½-inch x 3/16-inch angle iron. The two floor stringers are 3 inches x 3 inches x 3/8 inches angles punched and bolted in position to each frame, prior to arc welding. Angle iron stringers are also welded to each side of the channel frames. These stringers are also punched and bolted to the frames to maintain perfect alignment, until arc welded. Deck beams over the fore and aft bulkheads are 1½-inch x 1½-inch x 3/16-inch angles, arc welded directly to top ends of frames. Clamps formed from flat plate are arc welded to every other frame to carry the deck on both sides of the open cockpit.

A view of the interior of one of the boats from the uncovered aft bulkhead looking forward is shown in Figure 2. The engine base or mounting shown in this illustration is constructed entirely from ¼-inch steel plate, fabricated by arc welding and permanently joined to the floor or bottom of the craft and to the two floor stringers by arc welding. The engine base is braced on two sides by triangular pieces of steel plate with bottom edges crimped and arc welded to the bottom plates. The coaming around the cockpit consists of one piece of 2-inch x 2-inch x ¼-inch angle on each side and end. As can be seen in figure 2, the rear end of forward bulkhead is fabricated by riveting, so that it may be removed, when desired.

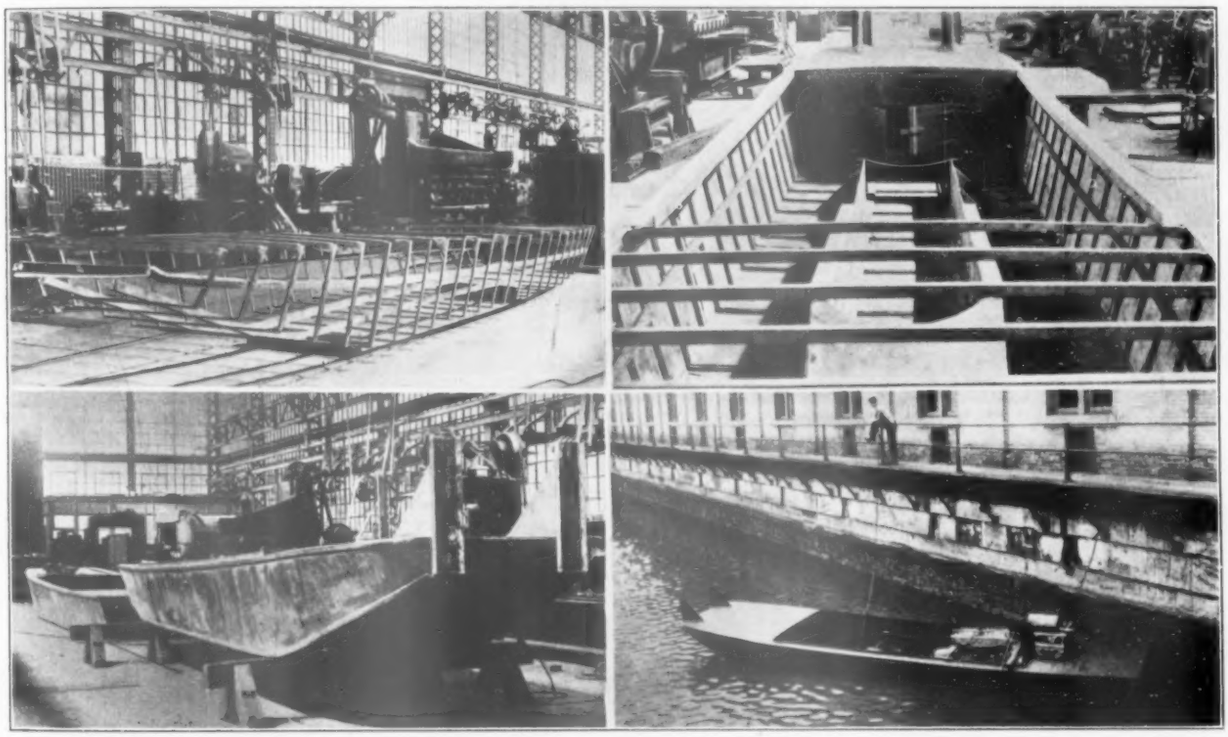


Fig. 1. Showing partially completed steel skeleton of hull fabricated entirely by the electric arc welding process.
Fig. 3. Steel plate arc-welded to an all steel framework makes a stronger, more durable and leak-proof hull.

Fig. 2. Interior view looking forward from aft bulkhead of arc welded, all-steel motor boat.
Fig. 4. The completed hull, with motor mounted, but before fittings and equipment have been installed, ready for trial run.

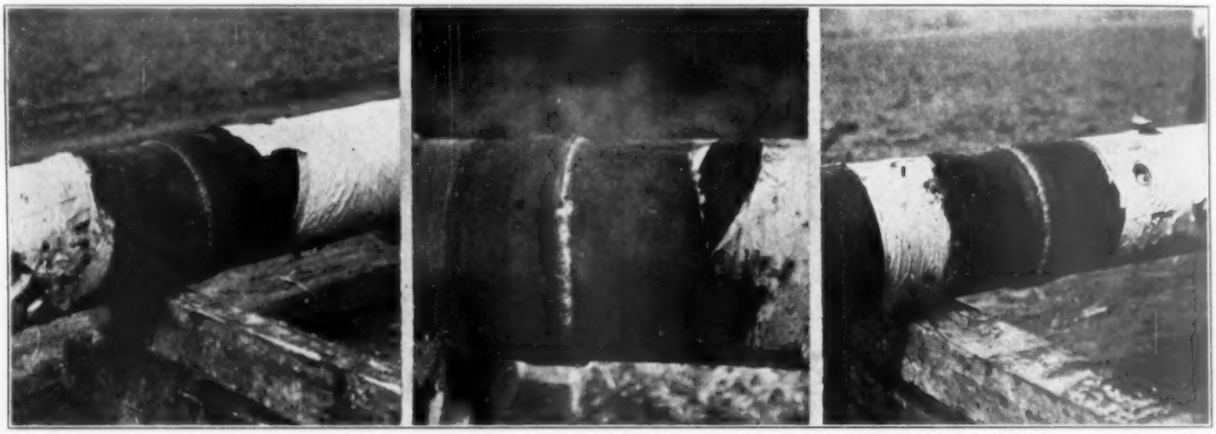
The bottom and side plates are joined to the frames by short fillet welds about 1½ inches long and approximately 7 inches apart. The bottom is of ¼-inch plate, the sides of 5/16-inch plate and the deck of No. 10 gauge sheet steel. Figure 3 shows a completed hull, in foreground, on which can be seen the continuous welds along the edges of bottom side and deck plates. The bumpers at the bow of the boat are for pushing barges. They are constructed of 8-inch x 13¾-inch channels, braced by triangular pieces of 5/16-inch plate, and 2 x 2 x 5/16 angles attached to the deck and prow by arc welding.

Each boat is to be powered by a 125-HP six-cylinder gasoline engine equipped with a reduction gear having a ratio of three to one. With this arrangement the boats obtain an average speed of approximately 13 miles per hour when running light. Figure 4 shows a completed hull with engine mounted, but before fittings and equipment have been installed, ready for a trial run.

The unique design and construction of these boats is a distinct tribute to the ingenuity and engineering skill of the Engineers Corps. The success of the design and construction of these arc welded all-steel motor launches, proven after a year's operation, marks a distinct step towards a new method of building power boats which will undoubtedly affect the entire industry. Not only does the substitution of steel, the stronger and more enduring material, for wood, mark an advance in small boat construction, but also the ability of the electric arc welding process to make a steel hull literally one piece of steel—which means a stronger, more durable craft absolutely free from leakage.

ARC WELDED SIX INCH PIPE LINE NEARS COMPLETION

An arc welded pipe line between San Antonio and San Marcos, Texas, a distance of 50 miles, is being built of six-inch pipe. This line, when completed, is said to be the first line of six-inch pipe that has been completely arc welded. The line is being built for The Texas Pipe Line Company by N. A. Saigh Company, pipe line contractors of San Antonio, Texas. All of the electric arc welding on this pipe line is being done by The Welding Engineering Company, Bartlesville, Oklahoma.



Left—Burning-in bead in bell and spigot joint. This is the first of two beads in making an arc welded joint. Center—The finish bead is arc welded directly over the burning-in bead in completing a joint. Portions of burning-in and finish beads as illustrated. Right—A completed arc welded bell and spigot joint.

The pipe used in this line was manufactured in unequal lengths, the lengths varying from 40 feet to 44 feet, the average length being approximately 41 feet. The pipe is lined up in sections consisting generally of six lengths, a total of about 246 feet of pipe. As the pipe used on this line have bell and spigot ends, the spigot ends are inserted in the bell ends in the lining up process. A section thus formed is blocked up level in a line parallel to the line of trench and then is ready for arc welding.

The welding of the joints in a section is known as firing line welding. Each joint is arc welded twice, the first bead being known as the burning-in bead, the second as the finish bead. By welding two beads over each joint, all possibility of leaks resulting from pinholes in the weld is prevented. In firing line welding the section is turned during the welding process, eliminating the necessity for overhead welding. As high as 38 joints have been arc welded by an operator in a ten-hour day on this particular line.

The joining of the sections to the pipe line is known as bell hole welding for the reason that the welder operator requires a bell shaped hole to be dug in the trench, so that he may have ample space in which to weld around the pipe. A bell hole joint is the only joint which requires overhead welding, as it is an impossibility to turn the pipe line. Two separate beads are welded in making a bell hole joint, the same as required in making firing line joints. Twenty-four bell hole joints have been arc welded on this line in a ten-hour day by one welding operator.

The machines used to supply the welding current on this line are of the gasoline engine driven type, manufactured by The Lincoln Electric Company, Cleveland, Ohio. The welding machines are mounted on wagons and moved along this line by teams. Welding electrodes, $\frac{3}{16}$-inch in diameter, also manufactured by The Lincoln Electric Company, are being used in making the arc welded joints in this 6-inch pipe line.

CLEVELAND MEETING OF A. W. S. PROMISES MANY GOOD PAPERS

The American Welding Society, through Chairman P. W. Swain of the Meetings and Papers Committee, announces the papers to be presented during the fall meeting of the Society to be held in Cleveland the week of September 9 as its part of the National Metal Congress.

The Iron and Steel Division of the Mining and Metallurgical Engineers, the Iron and Steel Division of the American Society of Mechanical Engineers, the Institute of Metals, and the American Society for Steel Treating will have conventions in Cleveland during the same week.

During the National Metal Congress the National Metal Exposition will be held, of which over 10,000 square feet will be devoted to exhibits of welding and cutting equipment and supplies; some 30 firms dealing in this material already have made reservations.

The papers to be presented by the American Welding Society are as follows:

"Non-destructive Tests of Welds," by Elmer A. Sperry, Sperry Development Company.

"X-Ray Investigation on Welds," by Dr. H. H. Lester, Watertown Arsenal.

"Oxyacetylene Welding of Pipe Lines in the Field," by W. R. Ost, Air Reduction Sales Company.

"Welding of Pipe Lines," by H. C. Price, Mgr. Welding Engineering Co., Bartlesville, Okla.

"A Metallegraphic Study of Some Metallic Arc Welds," by Prof. H. M. Boylston, Case School of Applied Science, Cleveland.

"Welding of Copper and Copper Alloys," by Mr. Hook, Research Laboratory, American Brass Co.

"Welded High Strength Aluminum Alloys for the Aircraft Industry," by Mr. Dawson, Research Laboratory, Linde Air Products Company.

"Foreign Practice in Welding of Boilers, Tubes and Drums," by G. A. Orrik, Consulting Engineer, New York.

"Stress-Strain Characteristics of Welded Joints," by Prof. J. H. Smith, University of Pittsburgh.

"Study of Nitroid Needles," by P. Alexander, General Electric Co.

"Cutting and Welding Steel Parts to Replace Castings," by W. J. Buchanan, The Bessemer Gas Engine Company, Grove City, Pa.

"Testing Equipment Used in Welding Industry," by W. G. Tatnall, Southwark Foundry and Machine Company.

"Machinery Design as Influenced by Electric Welding," by H. G. Boist, General Electric Company.

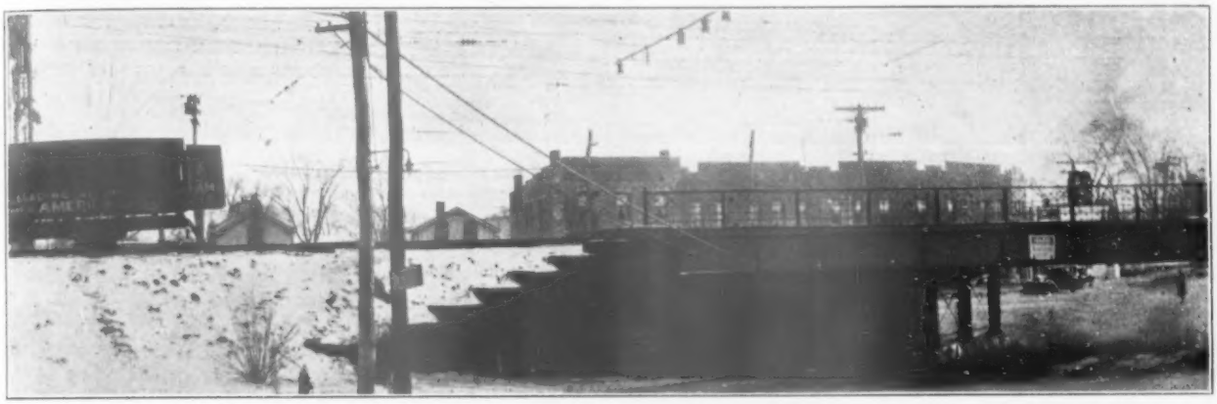
Repairing the Bridge at Darien

Methods of Repair of Railway Bridge Showed Great Economies and Caused no Interruption to Regular Traffic

By H. A. Sancken*

A GOOD example of the economies that may be effected by the application of welding is on railway bridge repairs. A condition sometimes found in old through plate girder bridges is the cracking of top flange stringer angles at the root of the angle.

Welding lends itself readily to the repair of this condition. A typical job of this character was completed recently on the N. Y., N. H. & H. R. R. bridge over Boston Post Road at Darien, Conn. This is a thru plate girder four track span on the main line in one of the busiest sections of the road. One of the most outstanding features of the job from the railroad man's standpoint was the total absence of interruption to traffic for the entire duration of the work.



The New York, New Haven & Hartford Bridge at Darien, Conn. Repair Welded by the Electric Welding Co. of America.

The stringers consist of plate girders which are composed of four 4 x 3 x ⅜" angles and ⅜" x 36" web plate, and the object was to restore the original strength of the cracked flanges by welding top cover plates and also welding the cracks. In this design the welds were computed to lie within a safe working stress of 8,000 pounds per square inch of fillet.

The following is a description of the procedure followed in the entire repair of the bridge, approximately in the order in which the work was carried out:

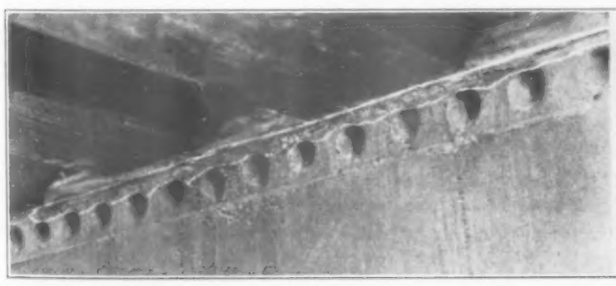
The top of all stringers between ties were thoroughly cleaned of all deposits, dirt, paint and other impurities. An air hammer was used for the purpose.

The cover plates of copper bearing steel, which had received one shop coat of paint except at the edges to be welded, were placed on the lower flanges of the stringers preparatory to lifting and placing them on the top flanges of the stringers under the ties.

The rails were raised by jacking from the tops of floor beams. The cover plates were lifted from the top of deck by means of rope attached to center of plate and which came through between the ties. When they were lifted to the proper level, the plates were slid into position and then centered and tack welded. The rails in that panel were then lowered and those on the next panel jacked. This process was repeated for all tracks.

C-clamps were applied at regular intervals to grip the outstanding legs of the flanges to the cover plates to insure tightness between the two surfaces. The edges were welded from the top and between the ties and the clamps were then removed. The cracks were cut into a V, with acetylene torch, all slag removed and surfaces thoroughly cleaned and then welded.

This bridge had been repaired by the riveted method some eight years before. The method then used to restore the cracked angles was to rivet patch plates to the flanges locally over the cracks.



View From Street Looking Up Showing Welded Cracks in Heel of Top Flange Angle of Track Stringers.

View From Street Looking Up Showing Cracks in Heel of Top Flange Angle of Track Stringers.

This necessitated retapping the ties wherever these patch plates occurred.

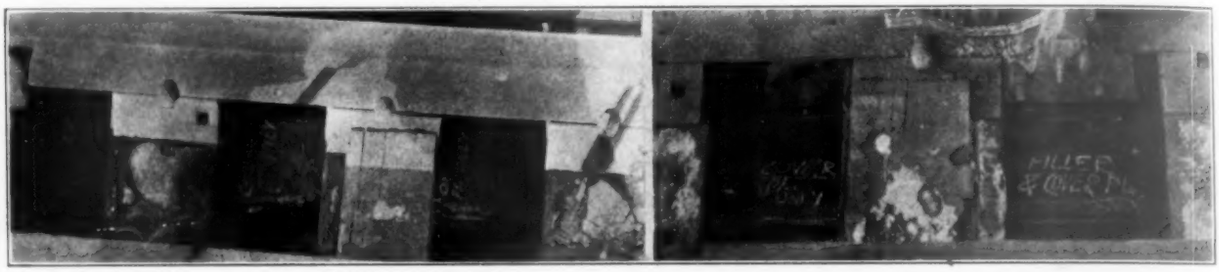
Therefore, to accommodate all the ties that had been retapped, filler plates of a thickness and length equal to the old patch plates were welded to the cover plates. Before the tracks were jacked, all rivet heads holding the patch plates were burned away, and when the ties were raised the rivet shanks were driven out and the patch plates removed.

After all welding was completed, all new steel and all welds received a coat of red lead and linseed oil. During the progress of the work extra precautions had to be taken to prevent sparks from reaching the street below. Owing to low street clearance all scaffolding was arranged from the lower flanges of the stringers and nothing was allowed to project below these flanges. Often it was found expedient to work from atop a ladder.

*Electric Welding Co. of America, Brooklyn, N. Y.

The source of welding current was obtained from a gasoline driven double generator unit with capacity for two welders, mounted on a gasoline driven truck. A compressor supplying the necessary air for cleaning, etc., was coupled off the gasoline engine driving the generators. The current supplied to the arc averaged 200 amperes and the electrode was ⅛ inch diameter. Roebling wire of structural grade was used.

Strain gauge readings taken before and after the cover plates were welded and with approximately the same loading conditions, indicated that the live load flange stresses were cut in half.



Cover and Filler Plates in Place and Welded to Top Flange of Track Stringers.

The following items of cost entered into this job:

10,020 pounds of steel.

500 pounds of welding electrode.

2,200 cu. ft. of oxygen.

1,132 cu. ft. of acetylene.

Welding Cover Plates to Top Flanges of Track Stringers.

800 labor hours, welding, cutting, cleaning, handling, etc.

240 hours truck maintenance and general work.

20 working days from start to finish.

15 total number of hours tracks were out of service to allow the placing of the plates and tack welding to hold the same in position.

29 days of flagman furnished by railroad.

32 hours of inspection.

396 feet, total amount, of welding (includes cover and filler plate).

177 feet, total amount, of welded cracks in flange angles.

330 gallons of gasoline.

2 gallons of oil.

Lumber for scaffolding, paint, board, telephones, trips to and from home office, and other incidentals, not included in the above, form about 10% of total cost.

The repair was designed and erected under the direction of E. Gagel, Chief Engineer, N. Y., N. H. & H. R. R., with P. B. Spencer, Engineer of Structures, in direct charge of construction. All track raising was done by railroad company's forces. All welding and erecting was done by The Electric Welding Company of America, Brooklyn, N. Y.

BOSTON SECTION PLANNING STRUCTURAL STEEL CUTTING AND WELDING EXHIBITION

On October 10, 1929, under the auspices of the Affiliated Technical Societies of Boston, the American Welding Society will conduct at the Massachusetts Institute of Technology, Cambridge, Mass., a meeting to start about noon and last well into the evening, devoted exclusively to the cutting and welding of structural steel.

Actual welding operations will be in progress during the meeting, requiring the use of two cutting and three welding machines. Structures thus welded will be subsequently tested to destruction in the presence of the audience.

Following is an outline of the meeting:

Cutting structural steel to shape and size.

Welding above steel to drawing dimensions.

Papers on cutting and welding.

Testing to destruction structures welded.

It is expected that such a meeting will be of importance and value to all those either directly or indirectly concerned with the cutting and welding of structural steel. Men prominent in all branches of engineering coming under the jurisdiction of the Affiliated Technical Societies of Boston will be attracted to the meeting.

Excellent laboratory and shop facilities have been offered by the Massachusetts Institute of Technology in connection with this work, together with their whole-hearted cooperation.

INTERESTING JAPANESE MANUSCRIPT ON RESEARCH

There has been received a reprint from the Memoirs of the College of Engineering of Kyoto Imperial University a treatise on "Theoretical and Experimental Researches on Electric Resistance Welding," by Takesi Okomoto. This includes theoretical investigations and experimental investigations of percussion welding, the distribution and change of temperature in butt welding, changes in structure and hardness, research on butt welding of soft steel bars, relations between welding from power and energy consumption, effect of various welding conditions on the tensile strength of welds, the butt welding of copper bars, and the butt welding of brass wire. The report of this research covers 111 pages and is well illustrated with photographs, diagrams, charts and microphotographs.

THE INSTITUTE OF METALS

The forthcoming congress of metallurgists to be held in Dusseldorf from September 9-12 promises to be extraordinarily interesting. Already nearly 200 persons from all over Europe—and some from America—have indicated their intention to participate in the gathering.

The congress will comprise (a) the presentation and discussion of about 15 scientific and practical papers relating to metallurgical work; (b) visits to works in or near Dusseldorf and Berlin; (c) receptions, dances and other social functions.

Persons who desire to participate in the congress should write for particulars to the Secretary of the Institute of Metals, Mr. G. Shaw Scott, M. Sc., 36 Victoria street, London, S. W. 1.

Fabricating Cutting Tools

Hard Facing Materials and Diamond Substitutes Are More Extensively Used as Methods of Application Are Improved

By M. C. Smith

THROUGH the process whereby abrasive resistant alloys are welded to the cutting edges of oil field drilling tools, the petroleum drilling industry has been revolutionized. Oil wells are drilled to depth of more than 7,000 feet at a speed quite beyond belief and the drilling tools survive a hardship of service which no oil well drilling tool of a few years back could endure.

As an aftermath of the success experienced in oil field tool applications, every branch of the metal working industry has attempted to adopt this welding-on process. The metals market offers several types of alloys, whose purpose is to leave a deposit of "near diamond hardness," after they have been applied to a metallic surface by a prescribed welding procedure. No single alloy is, however, a "cure-all" for any and every sort of deterioration and wear.

For a long while the manufacturers of these abrasive resistant alloys were as much at sea regarding the useful limits of their products as the ones whom they were trying to sell. The market, as well as the applications for such a material appeared, at first, to be without limit, but could not be developed without considerable preparation for supplying specific shop information. Quite naturally, therefore, progress in this field has been gradual rather than spectacular.

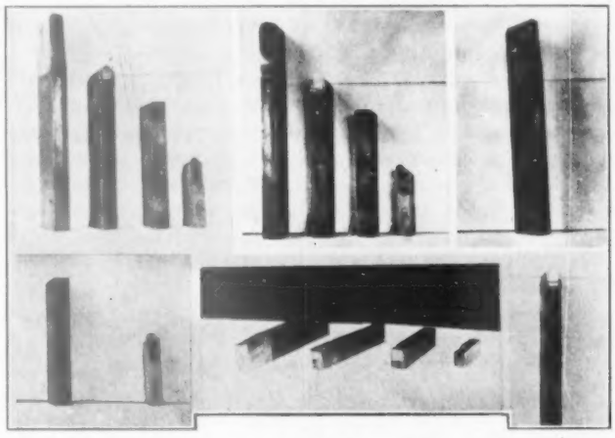
A few of the more conservative manufacturers of alloy welding rods and diamond substitutes have conducted sufficient research to supply intelligently any and all desired information. In consequence, these few manufacturers have segregated the good from the bad and are in a position to advise and assist. Furthermore, these few manufacturers have conclusively proven that there are hundreds, perhaps thousands, of instances where these recently developed alloys may be used to advantage in machine shop procedure. Likewise, they have learned that the process, as a whole, has its limits and particularly when it is applied to the fabrication of metal cutting tools.

Many years ago, the practice of welding high-speed steel bits upon a soft steal shank to form a metal cutting tool came into general use. About at the same time, a patented alloy metal was introduced which was designated as Stellite and which, if used instead of high-speed steel in the same procedure, was capable of producing greater production under the right conditions. Stellite, which has been described as an alloy of Tungsten, Chromium and Cobalt, containing little or no Iron, was found to have characteristics quite peculiar to itself. For this reason, its applications were, to some extent, limited, yet it was found to have a wide application to production machine work.

So, some years later, when the process of applying alloys to metallic surfaces by utilizing the alloy as a welding rod had been developed, the success of Stellite in the machining shops prompted a similar invasion by the new process. Why not, instead of welding on solid pieces, deposit alloy metal on the soft steel shank with a welding torch or electric arc? The procedure sounded quite feasible, and when put to use has been found very successful, giving a remarkable increase in efficiency to many tools.

Practically all, if not all, of the recently developed abrasive resistant alloys used in connection with welding acquire their abrasive resistant qualities through a content of the metallic element Tungsten. Tungsten is hard, has a very high melting point, resists wear and alloys with other metallic elements quite readily under the proper conditions. Like many other hard substances, however, Tungsten acquires hardness at the sacrifice of qualities which are quite as desirable. To compensate for this, the Tungsten must be alloyed with other metallic elements before it is fit for use, even to form an abrasive resistant surface. For the fabrication of metal cutting tools, pure Tungsten would be all the more unsuitable.

To date, metallic alloys containing a percentage of Tungsten have been developed and marketed which are actually of near-diamond hardness, but, when these alloys are subjected to the heat of the welding torch or the electric arc and are diluted by being fused with the metal to which they are being welded, the deposit left after the process does not have all of the characteristics of the original alloy. For this reason, all of the experience and experiments, so far, suggest that, in the fabrication of metal cutting tools, the best procedure is one which will afford no opportunity of heating the alloy to a fusing heat.



Various Views of Cutting Tools Showing Location of Hard Surfacing Materials.

In the oil fields, there have been two distinct processes of preparing the cutting surfaces of the drilling tools. One process consisted of veneering the surfaces of the tool which were exposed to wear with a layer of abrasive resistant alloy. In this process, the alloy is utilized as a welding rod and is fused with and to the surface of the tool. In the second process, the cutting edges and surfaces of oil field tools are reinforced by the insertion of bits of metallic alloy which is actually of near-diamond hardness and which is not fused to the metal in its application. This latter material and this latter method of application has also been found suitable and adaptable to the fabrication of metal cutting tools.

A series of tests, extending over a period of years, have been made with an alloy marketed as Borium and metal cutting tools fabricated with it have proven successful in many phases of machine shop practise, clearly demonstrating that such tools are entirely practical.

Borium, like all such alloys, is hard. It has an extremely high melting point and when fractured, exposes a clean close grained structure at the fracture. To use this alloy in the fabrication of a metal cutting tool and attain the best results, the shank to which the alloy is to be applied should be machined to form a recess of the necessary size and shape in which the alloy may

be inserted and held. Borium and many other such alloys may be shaped to a sharp cutting edge, but, for the most satisfactory results, there should be no attempt made to acquire any great angle of rake and the alloy insert should be well supported. Such alloys fracture readily, especially when chilled, and, in their applications, every opportunity to induce fracturing should be avoided.

Detailing the process used in the fabrication of such a metal cutting tool, after the shank has been properly recessed, the alloy insert is tinned. It has been found that, while in oil field tool fabrication, the alloy inserts are welded in place, for the fabrication of a metal cutting tool, the alloy insert may be brazed to the shank with the most satisfactory results and with no danger of destroying the metallic structure of the alloy.

As has been stated, the melting point of Borium and similar alloys is exceedingly high so, although heat sufficient to melt the alloy would destroy it for this particular service, the alloy should be well tinned for this operation, even if it is necessary to bring the alloy insert to a white heat in the procedure. Then, after the insert has been well tinned, it should be brazed into the recess made for it, using the same flux and the same procedure as in any brazing operation.

Next, after the alloy insert has been brazed to its shank, the insert must be ground to the desired shape for service. This grinding procedure requires considerable care, more because of the alloy's hardness than because of any danger of injuring the alloy during the process. To grind Borium, and the same thing undoubtedly holds true of any similar alloy, a Silica Carbide grinding wheel must be used, rough grained for shaping and fine grained for finishing, and while this grinding may be done either dry or under water, the best results are obtained by grinding under water. When finished, the alloy insert should have a very highly polished surface, a sharp, well defined cutting edge and be free from any perceptible surface checks or rough spots.

Fabricated metal cutting tools are profitable investments for every class of metal machining procedure. Even if the tools be fabricated by welding or brazing in these rarer metallic alloy inserts, they may be economical investments for any and every operation. They have their specific places in machine shop procedure and in such services prove highly satisfactory. This particular type of fabricated cutting tool will maintain a cutting edge with little or no perceptible wearing away so that machining operations entailing long cuts to close dimensions are possible. Likewise, these extremely hard alloy inserts will readily machine chills, hardened steels and cast iron welds. The tools attain their best results when kept hot, or, at the least, warm, so are inducive to higher speeds and feeds. The one condition to guard against particularly is the subjecting of such tools to severe shocks. Present-day metallurgy has found no way to overcome the brittleness which accompanies the hardness of these newly developed metallic alloys.

For many years, metallurgists have been endeavoring to develop metallic alloys for specific purposes. In most instances, they have been quite successful, but, in the case of developing alloy welding rods, they have been and still are baffled. An alloy may be developed which will have any and all desired characteristics, but, when this alloy is applied by welding, the deposit left after the process may or may not be satisfactory for, in the process of welding, a certain amount of change in chemical and physical properties is inevitable. Whatever process is used, the welding rod, particularly if it be an alloy rod, is subjected to more than 6,000 degrees, Fahrenheit, temperature and, with this temperature, almost any sort of a fusing and refining process is possible.

So, while it is possible to weld on a deposit which may result in a satifactory metal cutting tool, there can be no certainty that any one material or proces is a cure-all. Each new development is watched with interest in the machine-tool field and welding methods continue to solve an increasing number of cutting problems.

WELDING A LARGE STEEL PIPE PITTED BY ELECTROLYSIS

An interesting article found in the June 19th issue of the Water Works Engineering describes the repair welding of a large steel water main which had become badly pitted through the process of electrolysis. This pipe had been installed in the Borough of Richmond, New York, and was 66 inches in diameter and 16,600 feet long. It was made of $\frac{7}{16}$-inch riveted steel plate which was coated with a bitumastic enamel. The main passes an electric power substation and then parallels an overhead trolley track. Due to financial difficulties the trolley system was poorly maintained and the rails inadequately bonded.

The first leaks were found early in 1927 and were repaired by welding. At this time the difference in potential between the water main and the track was seven volts. A steel plate was placed to bond the pipe to the track, but was not successful in stopping the electrolysis. Finally the trolley line was abandoned and the borough decided to lay a concrete pavement over the road. The New York Department of Water Supply determined to repair the main before the road was paved. So a contract for repair welding the pipe was let.

An estimate of 8,000 pits to be welded in about 800 feet of pipe was made based on test holes dug to inspect the main. But in a length of 723 feet were 40,000 to 50,000 pits of which 25,040 were welded. The rivet heads were most seriously attacked and from 5,000 to 6,000 were welded. An inspector marked all pits that were to be welded, and the small depressions were only cleaned out and filled with bitumastic coating. Generally the pipe was welded under pressure, a wooden plug being driven into the few spots where the plate as perforated and a plate was welded over the spot. The largest single spots were from 2½ to 4 inches in diameter and in five or six places there were sections about 6x18 inches that contained so many pits that a continuous weld was necessary. These areas as well as the smaller spots were built up by welding to give at least the original thickness of the plate.

One welding crew was employed continuously with a second crew as required. A crew would weld from 300 to 400 holes per 8-hour day. The surface was prepared with a wire brush, each hole being thoroughly cleaned out and then immediately welded. Each 30-foot length of pipe was recoated with bitumastic enamel as the welding was completed.

WESTINGHOUSE NIGHT WELDING SCHOOL

The increased interest and demand for practical instructions in electric arc welding have made it necessary for the Westinghouse Electric & Manufacturing Company to conduct night classes in practical arc welding instructions. This night course was started for the benefit of employes, whose employment during the day would not permit them to obtain welding instructions then. The course is open to anyone desiring arc welding training, who may be conveniently located for attending this school. A small tuition fee is charged for the three months' course.

The classes consist of two groups of students, each group meeting two nights a week for three hours each night for a period of three months. A competent arc welding instructor is in charge of these classes. The enrollment is limited so that the students may receive individual attention and instruction in the various phases of electric arc welding.

Such classes are also conducted in the day welding school, which is equipped with the latest design of arc welding apparatus, including both single and multiple operator equipment, as well as a full line of grinding and cutting machines. The regular day school is open to buyers or prospective buyers of arc welding equipment for special instructions without charge.

Effect of Molten Bronze on Steel*

Molten High Strength Bronze Applied to Steel Which Is Free from Stresses Will Not Penetrate or Cause Cracks

By L. T. Hook†

Scope of Discussion

IN THIS paper we shall discuss the effect of flowing molten bronze upon steel. We cannot go into the question of the laws governing the relative solubilities and rates of diffusion of the two metals but shall confine the discussion to the liabilities incurred by the flow of the molten bronze on the steel and the conditions governing the effect of the one upon the other.

It has long been known that molten metal flowed upon a solid metal will sometimes cause cracks in the latter. Thus, the cracking of severely cold-worked brass by the action of mercury is a typical example. Such cracking sometimes occurs in metals carrying high internal stress when acted upon by a non-metallic agent such as a chloride, an acid or an alkali. Hence it is sometimes called "corrosion chacking" or "season checking."

Aside from the chemical reactions, the variables governing the effect of the molten bronze on the steel may be stated thus:—(1) intimacy of contact, (2) relative mobility, (3) temperature and (4) stress conditions. The latter will be shown in this paper to be by far the most important.

Previous Work

Sir W. Roberts-Austen[1] writing on the diffusion of metals reviews the work on Spring who in 1894 proved that if the carefully surfaced ends of cylinders of two metals were strongly pressed together and maintained for 8 hours at 180 degrees to 400 degrees C., interpenetration would take place, true alloys being formed at the junction of the two metals.

In this instance both metals were solid. Intimate contact, made more intimate by pressure, was proven essential and the diffusion was found to be hastened by elevated temperatures. The writer suggests that the elevated temperature is necessary as a means of increasing the mobility of the molecules. Thus in the case of mercury, action takes place at ordinary temperatures because the latter is molten under such conditions.

Again the diffusion of carbon from the solid coke or charcoal into the solid iron during the cementation process of steel making is well known, high temperature being necessary. In a similar manner, W. N. Hindley[2] has demonstrated that arsenic will penetrate into steel to a considerable depth when placed in contact thereto at elevated temperatures.

In the above illustrations, where the element of stress on the contact surface was lacking there was no cracking but the diffusion into the base metal proceeded uniformly from all parts of the contact surface.

Importance of Stress on Contact Surface

Where, however, there is a tensile stress on the surface of contact, the penetration is conspicuously lacking in uniformity. It is a case of a rapid accidental penetration into the steel at odd points rather than a uniform diffusion inward from the common surface.

In an interesting discussion as to the cause of the failure of some thousands of 75 mm steel poison gas shell, Albert M. Partevini found that the cracks started invariably from the surface of the inner wall in the region under the rotating band. He showed that there was a residual tensile stress in this region due to the process of swaging the rotating band into place. He found no failures on proof testing the shells after the rotating band was in place and the machining complete, 1.2 to 5 per cent failures in shells which had been pickled in sulphuric acid, and ½ to 1 per cent failures in shells which had been tinned. Then numerous failures were noted in shells which had been loaded with vincenite (a mixture of hydrocyanic acid, chloride of tin, arsenic and chloroform) after storage of several months.

In this case, Mr. Partevin found that both the corrosive action and the internal stress were necessary to cause cracking arriving at a final conclusion that—

" . . . certain corrosive reactions may determine cracks in steel which is in a state of internal stress. . . ."

Working with brass as a base metal, H. J. Miller[4] found that molten tin or molten solder caused cracking to take place only when the stress was sufficiently high, his conclusion being stated thus:

"The cracking is primarily due to the presence of stress, either of an internal or an external nature. No cases of cracking have been experienced when it was known that stress was entirely absent."

Mr. Miller illustrated this point in an interesting manner with four series of brass tubes marked A, B, C and D. These tubes had progressive amounts of internal stress, A having the minimum and D the maximum value. The tubes were immersed in a 3 per cent solution of mecurous nitrate and various baths of molten metals with results as follows:

"A" did not crack in the mercurous nitrate nor in any molten metal.

"B" cracked in mercurous nitrate in 15 to 20 minutes but not in any molten metal.

"C" cracked in the mercurous nitrate in less than 1 minute but did not crack in any molten metal.

"D" cracked in mercurous nitrate in a few seconds and also in baths of molten tin, lead and solder in times varying between 5 and 60 seconds.

Another important conclusion drawn by Mr. Miller is to the effect that mercury acts much faster in causing cracks in stressed brass than does molten tin, lead or solder. This is all the more noteworthy since the action of the former takes place at ordinary temperatures while the latter were applied at an increase in temperature of several hundred degrees.

Original Work

Working under the direction of Mr. W. H. Bassett[5] the writer made an investigation into the action of molten bronze on steel and presents his findings in the following series of tests:

It had come to our notice that there was an occasional failure in a steel member that had been welded with Tobin or Manganese bronze. In every case the steel member was a part relatively thin and subject to rather high stress. An automobile frame is typical of this usage. Accordingly, 5/32-in. thick automobile frame steel was selected as the base metal for the investigation. An analysis showed .242 per cent carbon, .418 manganese, .014 phosphorous and .028 sulphur.

A micrographic examination, of which Fig. 1 is illustrative,

[1]Introduction to the Study of Metallurgy, 1902, p. 73.
[2]Journal Iron and Steel Institute, 1924, p. 469.
*Paper read before the 29th Annual Convention of the International Acetylene Association, Chicago, November 15, 1928.
†Testing Engineer, American Brass Co., Waterbury, Conn.
[3]Journal Iron and Steel Institute, 1923, p. 84.
[4]The penetration of brass by tin and solder, Journal Iron and Steel Institute, 1927, p. 183.
[5]Technical Superintendent and Metallurgical for the American Brass Company.

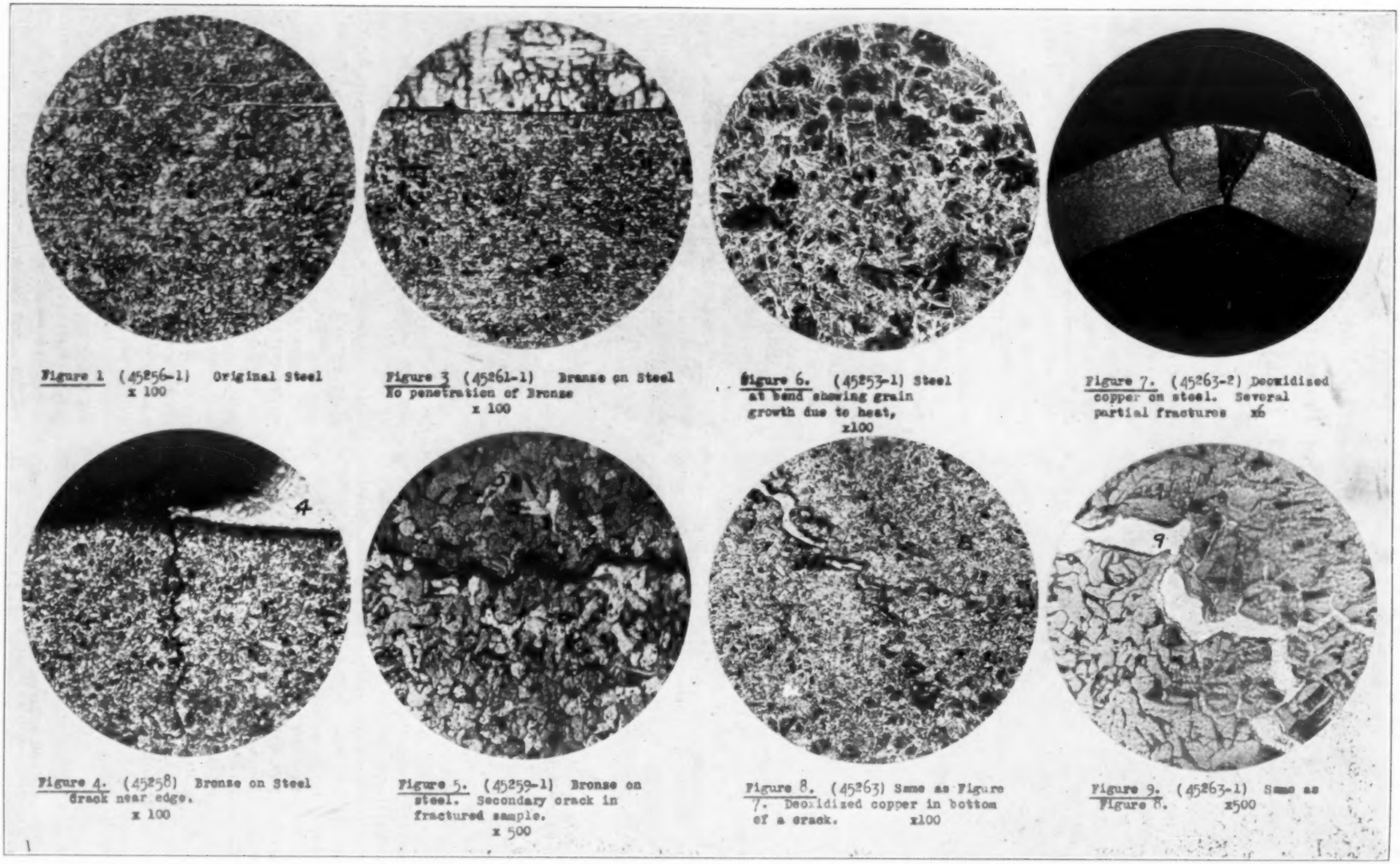


Figure 1 (45256-1) Original Steel x 100

Figure 3 (45261-1) Bronze on Steel No penetration of Bronze x 100

Figure 6. (45253-1) Steel at bend showing grain growth due to heat, x100

Figure 7. (45263-2) Deoxidized copper on steel. Several partial fractures x6

Figure 4. (45258) Bronze on Steel Crack near edge. x 100

Figure 5. (45259-1) Bronze on steel. Secondary crack in fractured sample. x 500

Figure 8. (45263) Same as Figure 7. Deoxidized copper in bottom of a crack. x100

Figure 9. (45263-1) Same as Figure 8. x500

Photomicrographs of Various Applications of Deoxidized Copper and Bronze to Steel.

shows the steel to be a clean, fine-grained perlithic steel with grains of .00063 ft. or less in diameter and occasional ferrite ghost lines.

Strips about 10 in. long were cut from the steel and machined parallel for a 2¼ ft. gauge length. They were then supported and loaded as illustrated in Fig. 2.

There is a uniform tensile stress for the two inches between the supports and its value is readily computed from the flexure formula for beams:

$$\text{Stress} = \frac{6W_0 l_0}{b\,h^2}$$ in pounds per square inch where W_0 is the load in pounds at a distance of l_0 inches from either support and b and h are the dimensions of the section of the test specimen. The stress was varied from zero to 6,500 lbs. per sq. in .by taking suitable values of W_0 and l_0.

The heating was done as indicated in Fig. 2 by means of an oxy-acetylene blow torch playing on the top surface of the specimen. Exact temperatures were not measured but varying degrees of heat from a low brazing heat estimated at 1,150° F. (620° C.) to a high brazing heat approximately

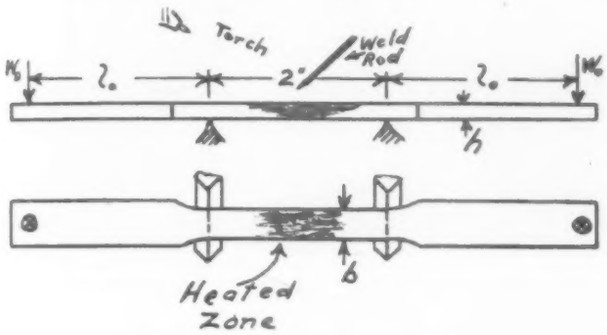


Fig. 2—Type of Test Specimen Used.

1,750° F. (955° C.) were tried.

The bronze was flowed upon the top surface of the steel test specimen after the latter had been brought up to heat. A high strength bronze carrying 39 per cent zinc, .8 per cent tin and the balance copper, was used for this purpose. A few tests using deoxidized copper carrying ¼ of 1 per cent silicon and .024 phosphorous were made in order to determine whether a similar effect was to be obtained and a few more tests with a third copper alloy carrying 3½ per cent of silicon and .15 per cent manganese were made for the same purpose.

Micrographic se ctions were cut from the finished specimens and polished in the plane passing through longitudinal axis of the test specimen and perpendicular to the top surface. Thus the trace of the contact plane was examined and any transverse cracks readily discovered.

Analysis of Results

From the numerous test specimens made and examined, the following typical cases illustrate the trend of the action.

See Fig. No.	Tensile Stress on Contact Surface lbs. per sq. in.	Remarks Except where otherwise stated the high strength bronze was used.
3	Zero	Good brazing heat. A careful examination disclosed no cracks and no penetration of the bronze. The absence of stress apaprently precluded accidental penetration and the time interval, a few seconds only before the freezing of the bronze, was too short for normal diffusion. The bond between the bronze and the steel is good for 40,000 lbs. per sq. in. or better.
3	1010	Usual brazing heat. Sample bent 4°. Otherwise results same as above.
3	1670	Identical results.
3	2010	High brazing heat. Sample bent 8°. Otherwise results same as above.
4	2590	High brazing heat. Sample bent 7°. A careful examination in the center of the bronze patch disclosed no cracks, but the crack illustrated in Fig. 4 was discovered near the edge. Apparently, the stress is approaching that value which will promote rapid penetration of the bronze. The sample did not break though the temperature was higher than usual and the torch held on the sample longer than usual.
5	6480	Low brazing heat. Sample broke suddenly with no bending. Apparently, this stress is sufficiently high to promote rapid penetration of the bronze. With only a low brazing heat, it was necessary only to touch the surface with the molten bronze to cause instant failure.
		Besides the complete failure which was covered with bronze, there were several other cracks of varying depth. In some of these the bronze was visible and in others not.
		Fig. 5 is a high magnification of one of these secondary cracks showing the fracture to progress most largely between grains.
6	6540	**No bronze.** Good brazing heat. Sample bent 55° with no indication of fracture. Fig. 6 shows characteristic enlargement of the grains due to the brazing heat.
7	6480	Deoxidized copper. Sample bent 55° with only several partial fractures. The
8	6480	deoxidized copper apparently exerts an effect similar to the high strength bronze.
9	6480	but is much slower in its action.
		The three microphotographs illustrate the mechanism of the fracture. Fig. 8 shows the copper alloy penetrating into extremely minute fissures, in one case where the crack was only .0001 in. wide, and Fig. 9 shows the penetration to be almost wholly intercrystalline.
None	6530	Silicon-Copper bronze. Broke suddenly with no bending. Several bad cracks besides the frature.

Discussion.

While the above illustrations are enlightening the mechanism of the cracking is not wholly explained. In some cases, there seems to be metallic bronze in the cracks and in other cases not. It may be supposed that metallic zinc vapors were preceding the molten bronze into the crack except for the fact that similar action was obtained in the case of the silicon bronze and there was no vapor from the silicon, copper or manganese at the temperature employed.

Of course, the fracture, once it had started, would proceed with cumulative rapidity due to the stress alone. The progressing depth of the crack would diminish the resisting thickness, h, of the beam and the stress would increase inversely as the square of h. This increasing depth of the fracture may be so rapid as to run away from the slowly flowing bronze.

While we have demonstrated resultant effects, we have not gone far enough into the investigation to determine the underlying cause of the weakening effect of molten alloys on steel. We believe this behavior is due to certain elements in the molten alloy producing intercrystalline attack in highly stressed steel. This intercrystalline attack being equivalent to nicking the metal under stress and fracture results.

Conclusions

While the investigation leaves some questions still unsolved, the following definite conclusions seem to be in order:

(1) *Molten high strength bronze applied to stress free steel at the usual brazing temperatures, will not penetrate the steel nor cause cracks in the steel.*

(2) *A low tensile stress of the order of 2000 lbs. per sq. in. in the contact surface is insufficient to allow penetration of the molten bronze, thereby causing cracks.*

(3) *A higher tensile stress of the order of 2500 lbs. per sq. in. or higher will offer opportunity for the accidental penetration of the molten bronze and fractures are likely to occur. Where the stress is 6000 lbs. per sq. in. or higher, the penetration is very rapid and the fracture almost instantaneous.*

Remarks

While the above conclusions apply particularly to the high strength, high zinc bronzes, the indications are that other copper alloys carrying no zinc and no tin will act similarily on steel though more slowly.

In the borderland between the safe and disastrous stress we could obtain bronze welds where the penetration was appreciable but the fracture only partial and not readily observed by the welder. It is important, therefore, that relatively thin steel members be kept free of tensile stress when being brazed or bronze welded.

The bronze applied to a stress free member, there will be no penetration or appreciable diffusion of the bronze into the steel at the usual temperatures the member will encounter in service.

COMMANDER BYRD PAYS TRIBUTE TO PLANE OF MODERN WELDED STEEL CONSTRUCTION

Commander Byrd's special copyrighted dispatch published on April 15 in the New York Times should prove of unusual interest to those engaged in electric resistance welding.

In that article, Commander Byrd vividly describes the hardships of Antarctic flying. One of the difficulties particularly stressed was that of landing and taking off from surfaces so rough that no pilot under ordinary conditions would attempt it. Due to these exceptional conditions the landing gear regularly withstands abnormal strains as part of each day's work. It is on the Ford tri-motored planes which Byrd has with him in the Antarctic that resistance welding has indeed proved its worth.

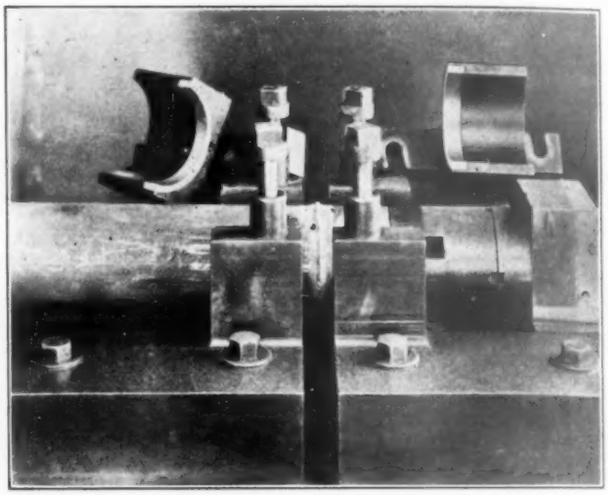
There are two welds on this type of plane which are of utmost importance; i. e., the flash weld on the struts supporting the landing gear and two flash welds on the motor fitting. Both are very difficult welds due to the fact that perfect alignment of the welded pieces must be maintained to prevent telescoping. The accompanying illustration shows the above-mentioned terminal strut in the welding machine immediately after being welded.

The success of these two welds could only be assured by the use of welding die material with sufficient hardness to accurately maintain its original shape after each weld and yet be of the proper electrical conductivity to produce a satisfactory fabrication of the metals.

Considerable difficulty was experienced with the die material formerly used inasmuch as it wore down very quickly and in some cases necessitated redressing of the dies after each weld to insure exact alignment of the welded metals.

Production was naturally held at a low level by this unsatisfactory die material and it was not until a new welding material was adopted that the two applications noted above could be considered commercially practicable.

This material which is now being used extensively throughout the Ford Industries is known by the trade name of Elkonite. The basic components of this alloy are copper and tungsten and the proportions of each can be so varied as to meet each individual requirement. The copper with its high electrical conductivity and the tungsten with its exceptional hardness form an ideal welding electrode or die. In instances where the metal to be welded is of high electrical conductivity, the copper is proportionately decreased so that the proper electrical resistance for a satisfactory weld will be maintained. In reverse cases the amount of copper is increased. It is therefore obvious that a



Terminal Strut in Position on Welding Machine Immediately After Being Welded.

welding material which can adapt its electrical conductivity and hardness to the requirements of the metals to be welded, is far superior to a die or electrode whose physical characteristics must necessarily remain constant.

It is interesting to note the comparisons between Elkonite and the former welding material which was used on the two-flash welding applications mentioned above.

In welding the terminals of the struts supporting the landing gear, the former dies averaged a maximum of 50 welds after which redressing was necessary. Elkonite dies on this operation have made 600 perfect welds and at the time of the last report they were still operating efficiently, an increase of 1250% in production per redressing! The same increase on the motor fitting welds has also been recorded,—the former dies making about 45 welds while Elkonite has made about 600 welds and was still operating at last reports.

Performance records of Elkonite on other installations in the Ford Plants show an even greater proportion of welds over the old die material. In fact Elkonite has made numerous welding applications commercially practical and is a factor which has been responsible for the notable increase in resistance welding at the Ford plants.

This rapid spread of resistance welding is not confined to Ford alone but has been noted throughout many large units of the automotive industries where increased production, and cleaner, better welds have been the direct result of its adoption.

This is fast becoming a reality in so many varied industries that it is now an accepted fact that electric resistance welding has indeed an extremely important place in industries where the fabrication of metals is a part of the production requirements.

Commander Byrd, who is in an excellent position to give welded construction the "acid test," pays tribute to the wisdom of this confidence in welding when he says ". . . . the strength of modern welded steel construction has been many times demonstrated."

Resistance Welding in Automobile Field

Spot, Seam and Flash Welding Each Play an Important Part in the Mass Production Programs of the Modern Factory

By M. L. Eckman

THE Automotive Vehicle is a tremendous factor in modern life. Interesting to all thinking people, because it decreases man's burdens, increases his pleasures and broadens and enlightens his mind. (Not to mention bruising his body and ruffling his temper occasionally.)

The public demand for a product of such universal benefit has created unusual conditions that affect every phase of life but more particularly the industrial field.

In the year 1877, thirty-four lbs. of steel was manufactured for every man, woman and child in the United States. In the year 1928, nine hundred and thirty-seven lbs. of steel was manufactured per capita of which fifteen and seventy-nine hundredths per cent (15.79%)—was used in making Automobiles, Trucks and Tractors. Concisely four and three tenths (4.3) times the amount of steel made per capita in the year 1877—was used per capita in the year 1928 for building Automotive Products alone. This is the stimulus that has caused the development of all metal working and other contemporary trades to such perfection as embodied in the 1929 Automobile.

I call your attention to "Welding" one of the youngest but by no means the least of these developments. If a motor car is going to be economical in the use of gas and oil and generous in the amount of mileage delivered it must be as light as possible consistent with safety and strength, all other factors being equal. Welding in Motor Car construction is necessitated by the demand for a strong, safe, light car of great utility, reliability and beauty.

The mechanical world was more than a century learning how to change large masses of metal such as ingots, billets and castings re-working the same into desired mechanical designed parts by forging, rolling and machining, a laborious and costly procedure at best.

Because of the advancement of Engineering design and the demand for Automotive transportation at low cost it is imperative that a means be found by which, chassis, body and control mechanism can be fabricated from standard commercial shapes of steel, such as sheets, tubing and bars.

Welding is the process by which two or more parts may be united into units of great strength and well proportioned design at a reduced cost never dreamed of by Engineers a few years ago. Further "Welding" encourages the development of the best productive practices such as "Stampings" and "Hot Press Work," because it is the process that makes these one so readily. Welding is a diversified subject, it is not a simple science. It has three major branches, namely Resistance Welding, Arc Welding, and Oxy-Acetylene Welding, just as medicine has pathology, therapeutics, and surgery. As a physician studies anatomy "I.E." Structures, and Physiology, "I.E" Functions, so the welder must study the structures and functions of the material upon which he exercises his art. As a physician determines the best healing agent and its application, so the welder must determine the best methods, prepare the subject and apply the weld with a hand and mind as skilled in his line as that of a great surgeon. To determine whether Arc Welding is superior to Resistance Welding is like choosing between therapeutics and surgery in medicine. Each has its distinctive field. However, Electrical Resistance Flash Welding has its particular field in the repetitive processes used in Automotive manufacture.

Electrical Resistance Welding follows its progenitor the Blacksmith and accomplishes its purpose by heat plus pressure properly applied. The Blacksmith heated his work in a forge to suit his eye (sometimes the steel absorbed impurities from the forge), then he removed it, cleaned it of Oxide by rubbing on the side of the anvil or other means, placed the two pieces together and hammered them vigorously. This procedure reduced to essentials is just heat plus pressure.

In Electrical Resistance Welding the heat is generated by the resistance of the parts to be welded to a controlled flow electricity of low voltage (2 to 10 volts) and high amperage (3,000 to 20,000 amperes). At the right time pressure is applied by hydraulic or mechanical means much better than by any hammer. This entire procedure takes only a few seconds of time, and is just heat plus pressure properly timed and controlled.

Resistance Welding in turn has three divisions, Electrical Resistance Flash Welding, Spot Welding with its sister Projection Welding and Seam Welding, of which Electrical Resistance Flash Welding is probably the chief.

Electrical Resistance Flash Welding is somewhat spectacular. The flash welding machine is the product of the genius of the skilled mechanic and the electrician. A tube and a terminal forging is placed in the jaws and clamped by a turn of the hand, a lever is pulled, there is a flash, a shower of sparks and the next moment you are handed the parts which have become one before your eyes in the fraction of a minute. This can be duplicated at the rate of 200 per hour or better with unskilled help at a current cost of $.002 per unit. This weld is as strong as the parent metal when properly made, and is reliable and good for any legitimate strain or stress. There is no overlapping of metal but a continuity of form that lends great beauty to the units. The machines that do this work are a clever combining of mechanical and electrical engineering to hold the parts, control the current, control and apply the pressure to the weld specimen. A transformer of suitable design changes high voltage A. C. current into low voltage, high amperage welding current. The correct timing and coordination of the mechanical and electrical functions are features of the machine.

Electrical Resistance Flash Welding is used wherever the over lap of metal in the pieces to be welded is not required, and applies equally to sheets, plates, tubes, bars, forgings and structural shapes.

Examples of this in Automobile Construction are:

The two terminal forgings to the Propeller Shaft
The two terminal forgings to the Foot Rest
The two terminal forgings to the Robe Rail
The two terminal forgings to the Propeller Shaft Housing
The two terminal forgings to the Brake Rods
The two terminal forgings to the Cross Shaft
The two terminal forgings to the Bumper Cross Brace
The two terminal forgings to the Lamp Bracket Rods
The two terminal forgings to the Steering Gear Connection Rods
The two terminal forgings to the Foot Pedals, Brake and Clutch
The two terminal forgings to the Radiator Stay Rods
Steering gear case to steering gear tube
Rear axle shaft housing to rear axle shaft bell and brake housing
Entire muffler assembly
The four corners of automobile doors
The four corners of automobile window frames.
Differential housing assemblies.

Spot welding is usually applied to overlapping sheets of metal such as auto body parts and is accomplished by placing two or more pieces between points of copper or copper alloy whose area seldom exceeds ⅛" and averages around ¼". Low voltage, high amperage current flows through the metal from these points. The resistance causes the spot to reach a fusing point instantly and the pressure from the electrode points completes the weld. This you will note is just heat plus pressure properly applied. From 500 to 2,000 spots per hour can be made in this way and the cost is very low. Spot welding is fast eliminating the squeaks that were parts of the automobile of former years. Bolts and nuts with their partner the rivet had a habit of loosening up from vibration and road shocks making many discordant squeaks. The spot welds will not loosen up or squeak from any vibration. Bodies are reinforced by spot welding braces and pillars at vital points until the body is a much safer and sturdier body than its weight would indicate. Male and female locating points are embossed or pressed into the component parts in the operation previous to welding so that the parts can be located in correct position quickly and spot welded at an astonishing speed. This method has eliminated to a great extent the cumbersome fixtures once used to locate this wind of work. Wire wheels are manufactured by this method, as are stud and plate assemblies, and practically all body part assemblies.

Projection welding is a faster method of spot welding and is so called because two or more projections are embossed on each of the pieces to be welded, in a punch press. The welding electrodes are flat copper blocks instead of points and all embossings coming together between the blocks are welded at one time. This method of welding is fast coming to the front, and the machines for doing this kind of work are developing into production leaders, efficiency and design being greatly improved. Projection welding seems destined to supplant spot welding in many cases, as it is faster and more efficient.

Seam welding reminds one of the sewing machine in its action. The pieces to be welded are fed between the copper rolls of a special machine at the rate of 40 to 60 inches per minute. These rolls conduct the current to the work, where resistance to the flow of electricity causes the heat. Suitable mechanism interrupts the current periodically so the effect is a series of spot welds following so closely as to overlap each other. This type of welding is useful in many ways. Probably the fuel tank is the ideal product, being of one piece, made so by seam welding, it is a sturdy, strong, air-tight container. The two-piece aeroplane type air fan is quickly made this way. No other method of assembly is so strong, sturdy and quickly applied to this type of design.

Truly, welding is the product of man's ingenuity in controlling nature's great forces and harnessing them to his will. One wonders just what will be the outcome when this prodigy of production methods has reached the peak of its development. Now in its youth it is one of the most wonderful production methods known, having every desirable quality by which we all benefit in having better automotive vehicles at lower cost.

900 MEN HAVE RECEIVED ARC WELDING INSTRUCTION AT GENERAL ELECTRIC SCHOOL

Students from every state in the Union and from several foreign countries, including a number of college graduates, have availed themselves of the opportunity to learn arc welding under competent instruction offered by the General Electric Company at the school established some time ago at its plant at Schenectady, N. Y.

A description and outline of the course, which requires three months for the average student, is given in an illustrated booklet recently issued by this company.

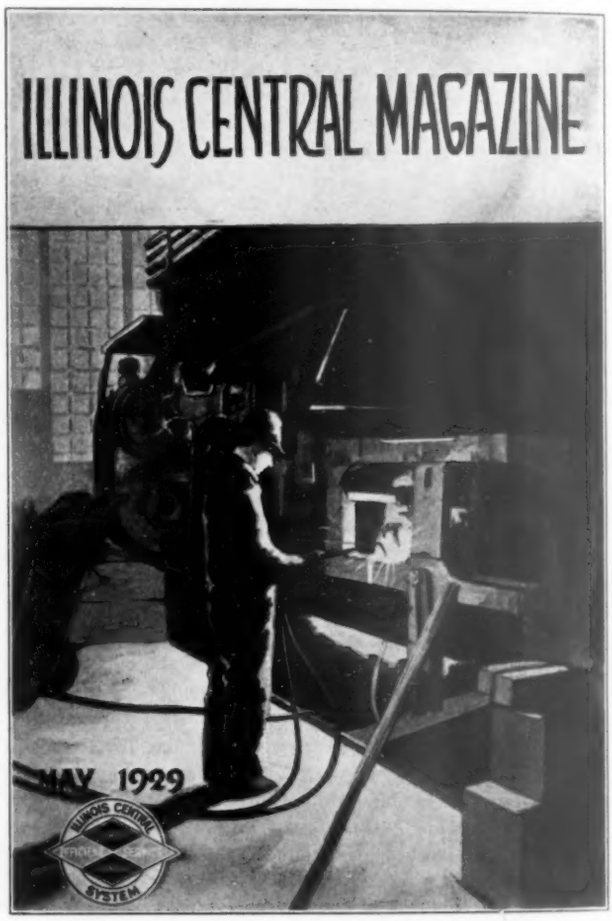
The school is open to any white man over 18 years of age, with satisfactory credentials, whenever there is a vacancy—under the following conditions:

Students must conform to the General Electric Company's standard rules and working hours, the latter being from 7:20 A. M. to 4:30 P. M., with one half hour for lunch, excepting Saturday, when the hours are from 7:20 A. M. until Noon.

No salary or wage is paid to the student, and no charge is made for instruction. It is necessary for the student to pay his own traveling and living expenses and also to equip himself with a few simple but necessary tools. A certificate of proficiency is given to each man who completes the course and who has attained the necessary degree of skill.

WELDING AND TRANSPORTATION

It is a pretty well-known fact that the railroads as a group represent one of the most prominent industries from the point of view of the amount of welding which they do. They were one of the first industries to give serious attention to the value of welding as a repair and reclamation process. Railroad welding includes almost every kind of repair welding known, in addition



Welding of Locomotive Frame Used as Cover Illustration.

to a considerable volume of what might be termed production welding and production cutting. Practically every railroad has contributed something to the progress which they have all made in finding new applications for the process. The accompanying illustration, which is made from a photograph of the front cover of the May, 1929, issue of the Illinois Central Magazine is an interesting study of a typical railroad welding operation. The fact that this particular job is used for the cover design of a magazine is an indication that the Illinois Central considers its welding department to be a department of considerable importance to the road. In fact it would probably be easy to show from their records that on many occasions a good welding job has been responsible for keeping equipment in condition so that schedules could be maintained, as well as representing tremendous annual savings in maintenance costs.

Short Cuts for Oil Field Welders

Making Patterns for Pipe Bends—Finding Lengths of Parts of Welded Elbows—Making Angle Iron for Cutting at Any Angle

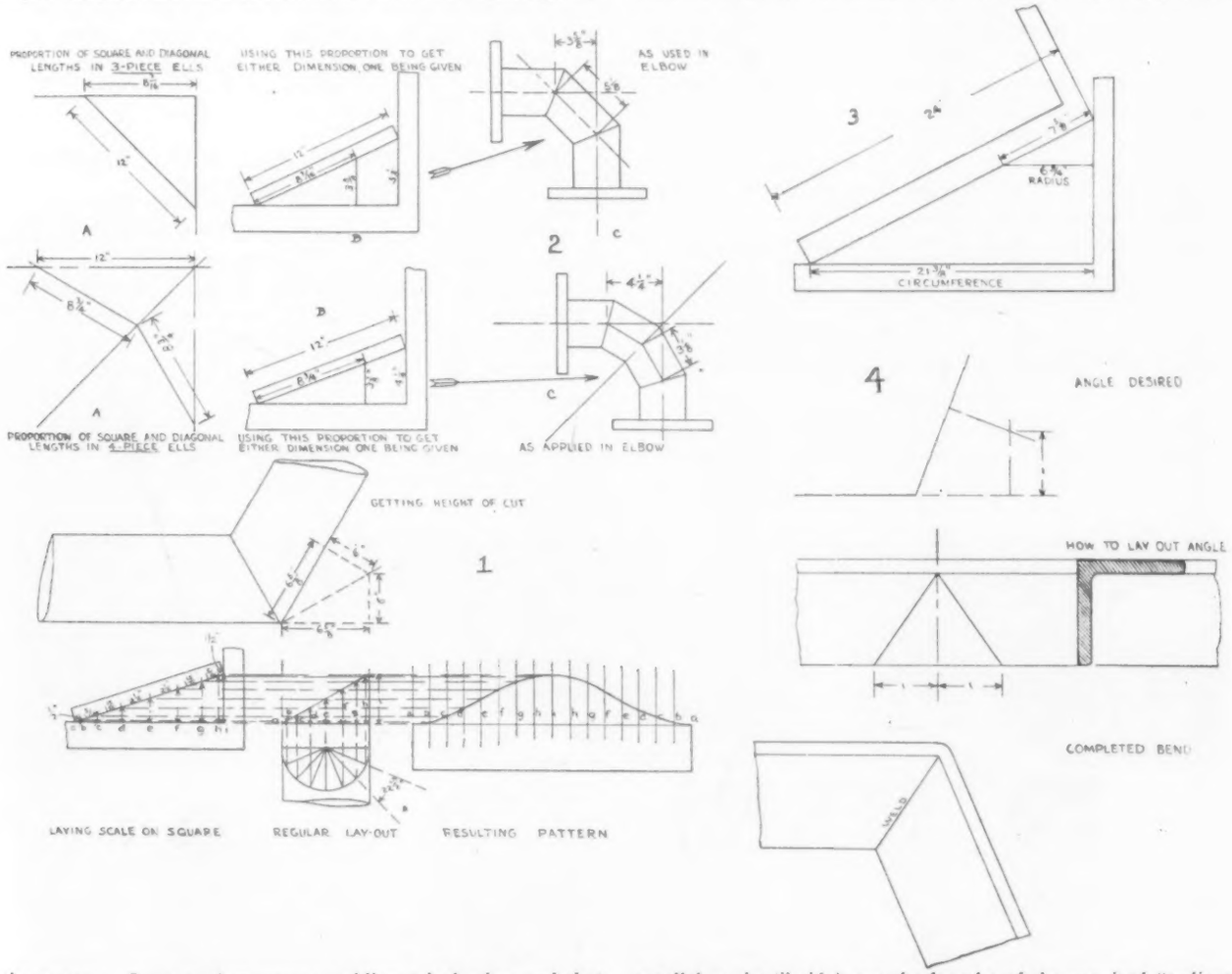
By C. R. Price

IN THE oil fields, and probably in a number of other places where the management depends on the welder to keep things going in spite of breakdowns and changes in plan, it frequently happens that welded turns in pipes, angle irons, etc., are wanted in a hurry. The laying out of patterns for this work is a tedious job and the following suggestions have proven so helpful that they are passed on to other welders to serve as short cuts wherever they can be applied. First is a short cut for making patterns for pipe bends.

First, get height of cut, that is, the amount the pipe cut is out of square, or the difference in height between lowest and highest points of the pattern. Suppose that we are welding 6-inch pipe, and that the angle of ditch that the pipe is to fit, is as shown in the sketch. Then just measure out along both sides of the angle 6⅝ inches (outside diameter of 6-inch pipe). Squaring off of these lines as shown, until the new lines cross each other, gives us (i), the high side of the pipe cut.

Second, get length of pattern and of each division in the standard way, by wrapping a tape or piece of paper around the pipe (in this case, practically 21 inches), and dividing this by folding, or in any way we like, into 16 equal divisions, marking division lines from (a) to (i) and back down to (a). Better yet, don't use any paper—put a line around the pipe (square with the axis)—divide into quarters first, and each of these into quarters again. With a piece of angle- or channel-iron for a guide, or with just a rule, draw a line through each division point, parallel to length of pipe.

Third, get length of "ordinates," that is, height of the division lines just found. *These are always the same proportion of height (i), regardless of size of pipe or angle of cut.* To get them, notch a 12-inch stick or scale as shown, and lay it across any square corner, such as that of bench or tool-box or carpenter's square, with one end of the stick away from the corner a distance equal to (i). Then the distances from each notch to side of square, (measured parallel to the 'i' side) are the lengths of the required "ordinates." The eight lengths we find, will do for the sixteen lengths of the pattern, because the pattern is made up of two halves that are just alike.



If you want to save time, especially with the smaller sizes of pipe, cut out every other division on the notched stick and on the pattern. Note that the divisions on the stick are 2¼ inches, 1⅞ inches, 1⅝ inches, starting from the center and going each way (the ½-inch on the end is what is left). [Now, if you forget these dimensions, or if you want to use some other number of divisions on your pattern, you can space the notches yourself, as follows. Lay out the lower half of a circle a suggested in the center sketch, but using

a 12-inch diameter. Divide your half-circumference into any number of equal parts. Then vertical lines from these division points will intersect your 12-inch diameter at the points at which you should notch your 12-inch scale.]

A Short Cut for Finding Lengths of Parts of Welded Elbows

Another use for the notched stick on the square corner, is in making two- and three-angle elbows. The proportion between lengths of center sections and the lengths that these represent along the center lines of the elbows is as shown. A scale notched at $8\frac{7}{16}$ inches for the two-angle ell, and at $8\frac{3}{4}$ inches for the three-angle ell, will give either dimension of the ell, if one dimension is known.

A Short Cut for Finding Circumference or Radius When Either Is Given

Again, you can get either diameter or circumference when you have the other, by notching your scale at $3\frac{1}{8}$ inches, or a two-foot square at twice the distance ($7\frac{5}{8}$ inches). By measuring your distances with a rule on which inches are divided into twelfths, you can read feet and inches for inches and twelfths.

A Short Cut for Marking Angle Iron to Get Any Desired Angle

Laying out angle cuts in angle iron. Use the same method as with pipe in finding "height of cut", or the amount the cut is out of square on either side of the center line, as *aa*. Only, when we measure out along both sides of the angle, a distance equal to the width of the angle iron, we shorten or lessen this distance by an amount equal to the *thickness* of the iron; and when we cut the iron, we start the cut under the flange, leaving one side of the angle iron uncut.

WHY WELDED STORAGE TANKS ARE BETTER

If there is any type of tank of which tightness and permanence of the joint is of prime importance, it is the station storage tank. Yet it was quite impossible until the advent of welding to build such a tank. When the heavy losses from leakage and evaporation of gasoline in the riveted station storage tank are considered, one cannot fail to be impressed with the potential savings made possible by welded construction.

Evaporation begins the instant the liquid comes in contact with the air. The exact amount lost through evaporation of any liquid in storage is difficult to determine, but as long as the tank remains in leaking condition, that loss mounts up day after day.

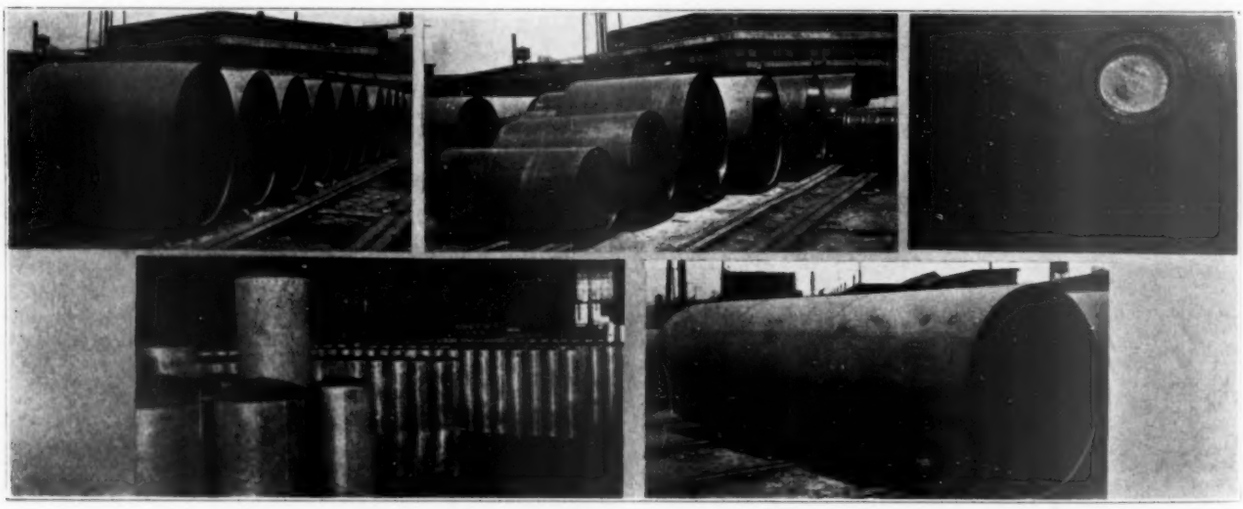
There is no upkeep of maintenance expense in connection with a welded tank. Initially tight, it is always tight. Experience has proven that a good welded joint is as strong as the parent metal. Since welded joints are so much nearer the strength of the metal they join, it is evident that welded station storage tanks are much better and safer for this particular service.

In the accompanying photographs, furnished by courtesy of the Central Steel & Wire Company, Chicago, are shown welded oil storage tanks of many sizes, including a 1,000-gallon tank, $\frac{3}{16}$-inch stock, 65-inch diameter, 72-inch langth, 502 inches of welding; a 550-gallon tank, $\frac{3}{16}$-inch stock, 48-inch diameter, 72-inch length, 392 inches of welding; a 2,000-gallon tank, $\frac{1}{4}$-inch stock, 65-inch diameter, 144-inch length, 805 inches of welding; a 3,000-gallon tank, girdle seams welded inside and out, 1,400 inches of welding.

One of the pictures is a close-up of an automatic arc welded seam and a hand welded spud. There is also a view of a range boiler stock room filled with all sizes of range boilers mostly all-welded, but a few riveted and welded. These were all galvanized after weding.

CONVENTION OF RAILROAD MASTER BLACKSMITHS

The 33rd Annual Convention of the International Railroad Master Blacksmiths will be held August 20, 21, and 22, at the Hotel Fort Shelby, Detroit, Mich. A display of products will be exhibited in the special hall set aside for that purpose. This will give all members an opportunity to discuss with each other the merits of the most modern appliances of all kinds for railroad blacksmith work. Those interested in obtaining space at this convention should make their reservations with Mr. Wm. A. Chamieux, Secretary-Treasurer, Blacksmiths' Supply Association, 230 North Michigan Ave., Chicago, Illinois.



An Annual Production of Thousands of Perfectly Welded Tanks Shows the Modern Trend of Tank Development.

PAMPHLET ON WELDING MONEL METAL

The International Nickel Co. has recently compiled a set of instructions covering the welding, brazing, and soldering of monel metal and pure nickel. Oxy-acetylene welding, electric butt welding, welding of castings, metallic arc welding, carbon arc welding, spot welding and automatic seam welding, in various applications are described and illustrated with drawings which show the proper procedure in each case.

Hints for the Welder

WHEN YOU FIND a new way to do a hard job, or finish a particularly interesting weld, can you describe how the work was done? . . . . . Have you learned some little stunt every welder ought to know? . . . . . Write to us about these things . . . . . This department helps you welders to help each other. Write up your ideas any old way and just make rough pencil sketches . . . . We'll fix them up for publication.

WELDING FOR PUBLIC SERVICE COMPANIES

One of the best possible sources of business for the job welding shop is the public utility company. The operations of these companies require a considerable volume of equipment of which a great deal can be made easily and economically by welding. Very often the welder can suggest considerable improvements in the ordinary working equipment of a public utility company and supplement it by the fabrication of special articles that can be used for special jobs. The Barton Brown Engineering Corporation, 1199 Santa Fe Avenue, Los Angeles, California, has done considerable work for public utility companies in their city. One interesting piece of welded construction which they recently completed is a derrick for handling telephone poles. Several views of this are shown in the accompanying illustrations. This complete outfit is practically all-welded construction that not only serves the purpose well, but makes it possible to handle poles in much less time and with a smaller crew than had ever been possible before.

Handling Telephone Poles With a Portable Welded Crane.

SILVER SOLDER IN THE POWER PLANT

By D. D. Detrow

Silver solder holds a very prominent place in the welding shop of a power plant. The uses are so many that only a few can be given. The first case that comes to mind, and the one in which the greatest amount of Silver Solder is used, is that of coating the low pressure steam turbine blades where they are badly eroded from the force of the condensate. When steam enters the turbine (I speak of those of 30,000 K. W. Capacity) the steam is at superheat temperature and the blades suffer no wear. As the steam progresses through the turbine and continues to expand it soon reaches the dew point or near atmospheric point and at this point the blades are badly pitted due to the terrible force with which the water in the steam is thrown against the blades. The base, the backs, and the reinforcing rods suffer no ill effects, but the sharp thin edges are worn and pitted until efficiency and balance are both lost. It is at this stage that Silver Solder finds a good application. These blades are coated with a thin layer of Silver Solder and all future erosion is stopped. A number of prominent electrical engineers are in favor of such procedure and some of them believe that in the future all blades will be coated this way before they are put into service. We use a number six alloy and a sixteen gauge wire for all around work. The following is a partial list of work done here with Silver Solder; Fourteen scores in valve seat ring of a main throttle valve for a 35,000 K. W. Turbine-Acetylene torch repairing; Copper floats and expansion joints; Altitude and relief valve radiators which contain alcohol; Superheat Steam gauges and Boardman springs.

Thorough cleaning is very important. The flux we use is powdered borax and water plus a small amount of wood or denatured alcohol mixed to the consistency of thick cream and applied with a brush.

There is one BIG DON'T and that is: Do not try to Silver Solder anything that has been soldered or babbitted without removing every trace of such by file or emery cloth (not by heating and wiping, as some have tried to do). A single trace of lead will cause bubbles and leaks.

LIFE OF ENGINE WHEELS PROLONGED

By J. C. Coyle

Probably nine persons out of ten are not aware that the drive wheels of a locomotive are supplied with tires. If they were not, the slipping and sliding from application of the air brakes, and other hard usage to which the drivers are continually subjected would occasion a tremendous loss from scrapping of valuable material. As it is the tire can be removed, milled over to restore a perfect face, and restored to its place. If it becomes too badly worn it can be scrapped and yet the major portion of the wheel remains in service.

If the tire becomes too loose to be made safe with a thin shim between it and the wheel the latter may be built up by welding. In the shops of the Denver & Salt Lake railroad this practice is followed in prolonging the life of the wheels. The latter are removed from the engine, in a drop pit, and placed, by a crane, on two strong tripods of steel, so as to be slightly off the floor of the shop. A circular burner of perforated pipe is slipped over the tire and an oil fire maintained by air pressure from a tank nearby, until the tire expands sufficiently to be removed.

When both tires are off the pair of wheels is rolled into the welding booth and built up a quarter to half an inch all around, by arc welding. Enough extra metal is applied so that the wheels may be milled down again to an even surface, and a liner ring, about ¼ of an inch deep, cut in one edge.

In replacing the tire it is secured to the wheel at the top by a short section of chain, heated up in the same manner as before, and driven on the wheel with iron bars when sufficiently expanded. Thus the railroads save the expensive material in these wheels which would otherwise have to be sold for scrap.

Preheating, Welding, and Finishing Operations on Engine Wheels Using an Oil Burner for Local Preheating

LOCAL PREHEATING ON ALUMINUM CASTINGS

In welding aluminum castings, it is usually recommended that the piece be carefully supported in the preheating furnace and preheated very slowly preparatory to the actual welding. Experienced aluminum welders, however, frequently dispense with the usual preheating furnace and handle even complicated jobs entirely with local preheating, using an oil burner for the purpose. The technique employed in this method is most interesting.

The illustration shows a welder at work on an aluminum casting 56-in. in diameter and ¾-inch thick, the lid of a rotary bottling machine, cracked from one edge about 20 inches toward the center. The circular shape of the casting made the expansion problem fairly easy, although it was complicated somewhat by a manhole opening at one edge through which the crack passed, and by the fact that when the reinforcing ribs passed through the center bearing, the metal was considerably heavier than elsewhere.

The lid had a crown of about 3 inches, which increased the difficulty of penetrating the full thickness without forming projections of metal on the inside. This was to be avoided as it would necessitate extensive finishing. Although preheating the entire casting in a furnace was unnecessary, it would be desirable to heat it locally along the crack, just ahead of the welding flame, so the welding heat would not bring on too sudden a rise in temperature and cause further cracking.

Briefly the procedure was as follows: A steel plate was formed to fit the inside of the lid, and clamped to it along the crack. Then the whole casting was fastened to a flat surface and the two sides of the break were aligned at the open end by a steel strap clamped in position. Then the opening was veed carefully.

First the whole length of the break was heated slightly with an oil burner. Welding was then started at the inner end of the break, with the preheater heating the aluminum thoroughly a few inches ahead. To insure a sound weld, both a puddling rod and cast aluminum flux were used. The puddling rod is used to remove oxide from the surface of the molten weld metal. As work progressed the preheater was still kept playing along the break, always a little ahead of the welding flame. This opened the crack up to the limit of expansion. As sections of the break were finished a covering of asbestos paper was put on, and all during the work great care was taken to keep drafts of cool air from the work.

Welding Job Preheated in Firebrick Charcoal Furnace.

With these precautions the welding went ahead quite smoothly, in fact, the whole break 40 inches long was completed in about an hour and a half. The job required little finishing.

PROPER HEATING PRACTICES

The preheating facilities necessary in any welding shop or department naturally depend upon the run of work handled. Cast iron welding forms perhaps a major part of the average welding shop's daily work and it pays the shop manager to give close study to preheating problems encountered in the various types of castings. Small pieces can be preheated by the oxy-acetylene blowpipe and welded without much difficulty. This method, however, is impracticable for larger pieces. A blacksmith's forge is

sometimes used for certain pieces, but with this there is the possibility of overheating or burning the metal on one side, if constant care is not exercised.

The most practical and most economical method of preheating large pieces particularly where the entire casting is to be heated, is the use of the temporary firebrick furnace. This is built of loose firebrick laid without mortar. It is quickly constructed and can be built to any size desired. The accompanying illustration shows a large preheating furnace encasing a heavy iron casting. Asbestos paper, having holes for draught if necesary, forms the top of the furnace. The spacing of the bricks around the base of the furnace

Welding a Job Preheated in Firebrick Charcoal Furnace.

assures sufficient draught to raise the piece to the proper temperature.

In order to keep a desired temperature, the fire must be regulated occasionally while the welding progresses. This is done by opening or closing the draught holes, rearranging the asbestos paper covering, moving hot coals from one place to another, or replenishing the fire whenever necessary. This important detail is usually performed by a helper. When the casting has reached an even, dull red heat, an opening is made in the asbestos paper cover just large enough to uncover the weld area, and welding is done through this hole.

After the weld is completed it is just as important to secure proper cooling. The entire casting or piece should be covered with fresh charcoal and brought up to an even heat. With the asbestos covering intact, the finished work should be allowed to cool and contract evenly in the dying fire. It is important that one part does not cool quicker than any other. If this happens the piece may crack due to an uneven "pull".

Preheating and annealing of cast iron is an essential part of welding technique. It is not a diffcult feature for the methods of constructing the preheating furnace and governing the preheating temperature are easily understood.

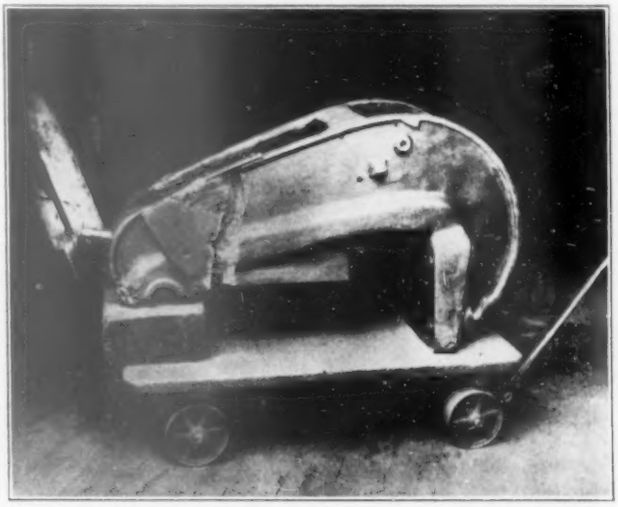
QUICK REPAIRS TO HEAVY PRESS FRAME

The heavy duty cast iron press frame shown in the accompanying illustrations was completely fractured throughout the length of an area which had been previously electrically welded with steel rods.

Because of the heavy work which this machine performed and the consequent strain upon the frame, it did not appear logical to again electrically weld the part broken, with steel rods, because of the imminent danger of another fracture at the same place.

The problem was submitted to an experienced welder who recommended and used Tobin Bronze to repair the break. Welding was done by one man in 3¼ hours, and 32½ pounds of ¼-in. Tobin Bronze Welding Rods were used for the work. Gas consumed amounted to 320 cubic feet of oxygen and 320 cubic feet of acetylene.

To prepare the weld area for a permanent bronze weld, it was necessary to cut and chip away all previously deposited weld material along the complete line of fracture. No pre-heating was necessary. Actual welding operations were carried out with two torches. A No. 12 tip was played on the areas ahead of the weld in order to bring the cast iron to the dull red heat, which is

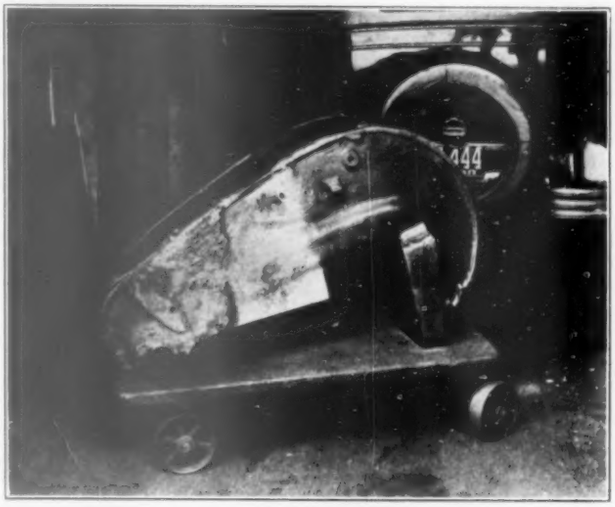


Broken Press Frame.

proper for melting on the Tobin Bronze. A No. 10 tip was used for depositing the bronze, care being taken not to play the hot inner cone of the flame directly on the rod or puddle. This avoided burning the bronze.

Bronze was selected by the welder because he considered a weld thus made to be at least twice as strong as cast iron. A break rarely, if ever, occurs in the same place where a good bronze weld has been made.

All welders who are called upon to repair heavy sections of



Welded with Bronze.

cast iron should be interested in the work illustrated. In order to weld a section of this size with cast iron rods, it would have been necessary to pre-heat the entire piece for many hours.

Welders generally are familiar with the discomforts experienced in working over a huge piece of cast iron which has been preheated for fusion welding. Bronze welding obviates the discomfort of heat radiation through pre-heating, saves the time of an extra man necessary for welding with cast iron, as well as gas and fuel for pre-heating and involves much less oxygen and acetylene gas because of the shorter welding time.

In instances where heavy pieces have failed because of a break in a section previously welded, new replacement castings are oftentimes ordered, rather than run the risk of a future failure.

Such embarrassing delays to production may be avoided by bronze welding.

The safe, sure strength of bronze, combined with the short length of welding time required, as well as the superior working conditions which prevail when it is used, should recommend its use among welders whose work calls for the joining of cast iron, malleable iron or bronze of any description.

WELDED STEEL SHEATHING FOR BRICK PILLARS

The brick pillars supporting an industrial building in down town Chicago were being badly damaged by trucks backing in to the loading platforms. In order to remedy this situation it was decided to give them a protective sheathing. The contract for this job was let to Western Welding & Equipment Co., of Chicago.

Repaired Brick Pillars and a Close-up of Method of Applying Steel Sheathing.

As can be seen in the photographs, the pillars are square with a sheet of steel for each face. After the sheet steel was put on it was found necessary to further protect the corners by fitting a length of angle iron over them. It was here that the welding entered. A bead was run the entire length of the angle on both sides in order to weld it firmly to the plates. As these were 64 inches in length with two welds to each angle iron and four

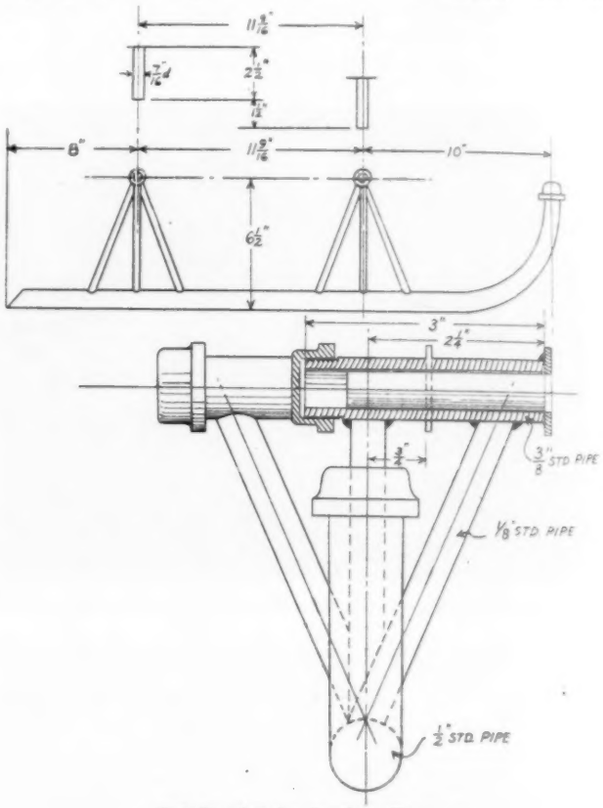
Welder at Work Repairing Pillars.

angles to a pillar there was in all 42 2-3 feet of welding done on each. As there were some 15 pillars this seemingly little job added up to about 640 feet of welding or more.

A motor generator set was hooked up inside the building and a long cable run out to the welder. At first the angle iron was tacked on, and then with them all tacked, the welder moved down the line of posts, welding the seams. All the welding was vertical and none of it was difficult. The job on the whole was a simple one, but it was very worthwhile both to the welding contractor and the owners of the building.

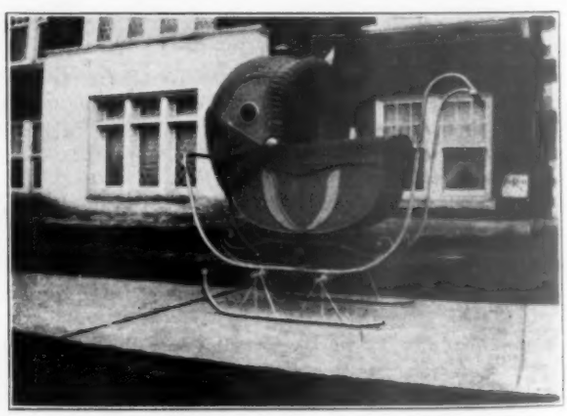
PUTTING THE BABY CARRIAGE ON RUNNERS

An ingenious welder living in the Chicago district encountered difficulty last winter when attempting to push the baby carriage around through the snow. Realizing the trouble his wife must have in moving the buggy over the snow and ice, he set to work and figured out a means of adapting the carriage to its winter environment. The successful result of his ingenuity is shown in the accompanying photograph.



Details of Baby Carriage Runners.

The runners were so made that they could easily be slipped on the axles in place of the wheels. Their construction is indicated in the two drawings. The first is a side view of the runner and shows its simplicity of structure. The second is an end view showing in detail the assembly



Ready for a Snow Storm.

of the supporting rods connecting the runners with the sleeves which fit over the axles. The structure of the axle-sleeve is plainly indicated and, as can be seen, a pin inserted through holes drilled in the sleeve and axle holds the runners firmly in place.

The materials used consisted of few pieces of standard pipe and pipe caps. There were four ⅜ inch caps used as can be seen over the ends of the axle-sleeves. Two ½ inch pipe caps were screwed on the front ends of the runners. The runners were made of two sections of half inch pipe 36 inches long. The four sleeves fitting over the axles were ⅜ inch pipe three inches long. Then there were four pieces of ⅛ inch pipe 6 inches long, and eight pieces of ¼ inch pipe 8 inches long used as the supporting rods connecting the runners to the axle sleeves. As one can see these materials were not very expensive, and yet the completed job was perfectly satisfactory and looked quite well.

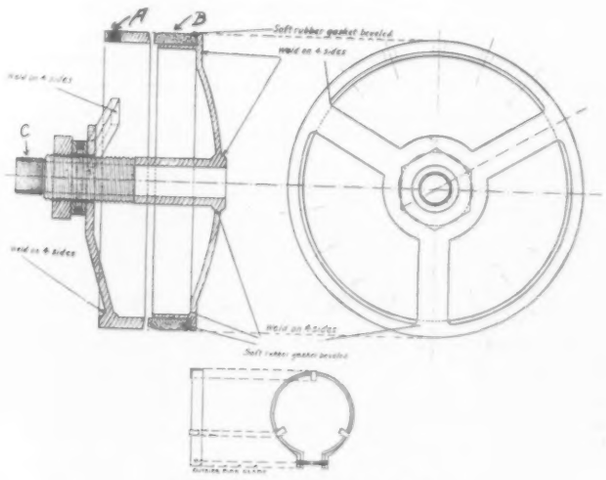
WELDING A TRACTOR GEAR CASE WITHOUT DISMANTLING

By J. J. Cardinal

We recently had fine success bronze welding a Twin City large size tractor. The break was under the left rear hub of the gear case. If the break had been on a straight line it would be 4 feet in length and about ⅝ in. thick to about ¾ in. deep. I used 9 pounds of Tobin bronze in making the weld. We first tipped the tractor over to have the break on the top side, then warmed up the entire casting by means of small wood fire under the casting and a kerosene blow torch. We burned the torch to its full capacity of 6 gallons per hour. While working we kept the torch burning constantly around the casting, not letting the flame come in contact with the casting. When the weld was completed we kept the blow torch heat working on the entire casting for about an hour and a half, having laid sheets of asbestos paper over the entire weld. When I removed the heat it was just hot enough that I could lay my hand on it. The job was done in open air without removing any parts of the tractor.

FOR TESTING PIPE LINES

During the construction of a long pipe line for natural gas which is being laid by the Pacific Coast Gas & Electric Company of San Francisco, a very interesting type of internal testing head was developed. The accompanying sketch which is taken from a blue print shows the construction of the device. "A" is the collar



Detail of Internal Test Head.

which goes inside of the pipe with studs which screw out against the inside pipe wall to hold this ring in place. "B" is a rubber gasket which goes all around this diaphragm. When a tension is exerted by tightening the screw "C" it expands the rubber gaskets tightly on the inner wall of the pipe making it air tight. The pipe is then filled with the desired air pressure for making the test and after testing, the head is quickly removed ready for the next job. Altogether it is quite a time saver and easily made from standard materials. It was developed jointly by Mr. R. B Wilson, Mr. R. A. Hansen and Mr. Dodge. We are indebted to Mr. J. C. Phillips of the Stuart Oxygen Company of San Francisco for supplying the photographs and data concerning this interesting device.

Internal Test Head in Use.

UNDER WATER CUTTING IN MILWAUKEE

An interesting under water cutting job was recently completed in Milwaukee by the Under Water Cutting Corporation of New York City. Mr. L. F. Hagglund did the work. The job consisted of severing a 54 inch steel covering which closed the storm sewer outlet into the Menominee Canal on the north span of the new Sixteenth Street viaduct. The cut was made 6½ feet under water and the work was done with the oxy-electric cutting torch, with which Mr. Hagglund has performed a large number of noteworthy cutting contracts. The cutting electrode was connected to two 400 ampere Hansen welding generators connected in parallel, getting from them 1000 amperes with overlap capacity. Although the depth was not very great the job was rendered somewhat difficult by the fact that the water was very muddy. It required about four hours to complete the work.

ARMCO ISSUES AN INDUSTRIAL ROTOGRAVURE

The American Rolling Mill Company of Middletown, Ohio, have sent out an interesting industrial rotogravure made up in eight pages, and picturing a wide variety of installations of pure iron sheets and plates as used in various kinds of industries the world over. The pictures illustrate the uses of Armco Iron found in such places as the Dutch East Indies, Zululand, Africa, Havana, Cuba, Costa Rica, Venezuela, Hawaii, and many others, not to mention many of the big industrial centers of the United States. Copies of this interesting pamphlet may be obtained by applying to the Publicity Department of the American Rolling Mill Company, Middletown, Ohio.

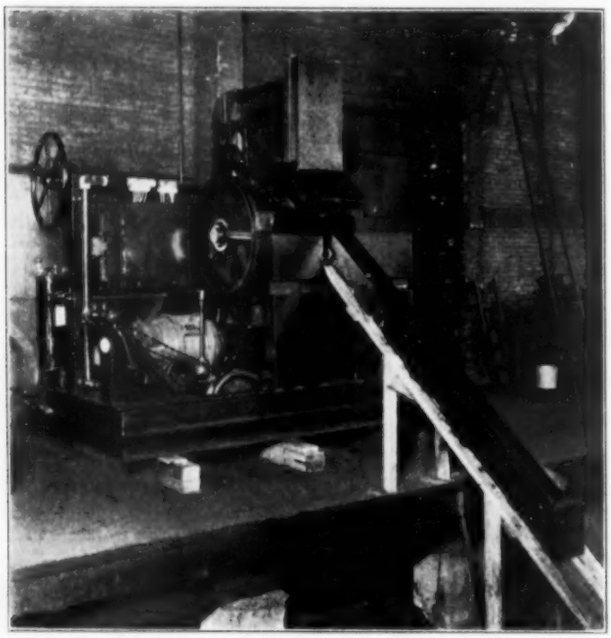
NEW I. O. C. APPARATUS FOLDER

The International Oxygen Company, Newark, N. J., have recenty issued an attractive two color folder describing two oxy-acetylene welding and cutting outfits which are assembled principally for the automotive trade. The first is called the International Garage Outfit No. 13, listed at $51.00, and provides equipment for welding, carbon burning, lead burning, brazing and soldering. The second outfit is called the International Automotive Outfit No. 15 and listed at $69.50, includes equipment for cutting as well as welding and consequently is adapted to a wider range of work. It is also supplied in a steel carrying case.

ARC WELDED STEEL COKE PUSHER

An electrically operated coke pusher of arc welded steel construction was recently built and installed in the Waterbury Gas Light Company's plant at Waterbury, Conn., by The Gas Machinery Company, Cleveland, Ohio. The coke pusher as shown in the illustration, is used for shoving coke out of an inclined gas oven and supplants the hand operated pusher formerly used.

In the building of this particular piece of gas plant equipment the electric arc welding process was used to make every permanent connection. This type of construction eliminated all punching, also driving of rivets, and materially reduced layout time. As can



Completed Coke Pusher.

be readily seen in the illustration, the welded connections required no connecting plates or angles as in riveted construction. Thus less steel was required and the weight of the machine considerably reduced. Increased rigidity and strength are also imparted to the frame of the coke pusher by use of the new construction. This is due to the fact that weld metal is considerably stronger than metal it joins.

Though the electric arc welding process has been used in the construction of pipe lines, blast valves, gas holders and gas purifiers, the Gas Machinery Company is the first to employ the improved method of joining steel in the construction of coke pushers and similar gas plant equipment. Welding equipment for fabricating and field construction work consists of a number of gas engine driven welding machines and a considerable number of other welding units manufactured by The Lincoln Electric Company, Cleveland, Ohio, and arranged for 220-volt or 440-volt, 3-phase, 60-cycle. It has been found that machines arranged for these two voltages will be usable for about 90 per cent of all power supply in the country.

ARCOS, INC. PRESENTS NEW CATALOG

Arcos, Inc. of La Crosse, Wisconsin, have issued a new catalog describing their coated arc welding electrodes. The catalog gives detailed information on the use of all the different classes of electrodes, telling the purpose for which each type is intended, what tensile strength and elongation can be expected, the amperage and voltage to use, and how it is best applied. Eight different types of electrodes are mentioned, each having its own trade name indicating its use. Four of these are coated steel electrodes, one for general steel welding purposes, another for welding alloy steel, a third for reinforcing manganese steel, and a fourth for reinforcing open hearth rails and frogs. A coated electrode is offered for the cutting and preparing of steel before welding. Two others are for cast iron welding. There is also included the "Alumend" electrode for the arc welding of pure aluminum alloys without special preheating. This is recommended for repairing motor parts, crank cases, pistons, etc.

A WAY OF DEFEATING HOT WEATHER

There are many reasons why night work may prove desirable or advantageous to certain industries. When harassed by adverse weather conditions, the farmer has learned to utilize artificial illumination to save his crop. The road builder, the structural worker, in fact, workers in many trades, have likewise learned that night work can prove quite profitable at times. While storms are the main cause for suspended operations in most outdoor work, yet extreme cold or heat can likewise be contributing factors. The last named cause was the determining factor in the following

Carbic Light Assists Night Work.

case. The successful solution of the problem makes a story worth recording.

A large stone quarry in the state of Texas found difficulty in keeping men at work in their pits due to the extreme heat which prevailed during most of the day. The situation became so acute as to practically suspend operations, and the management, in desperation, hit upon the idea of working nights instead of days. The men readily took to the idea and the plan proved a big success.

The scene of this particular quarry's operations was considerably removed from the nearest town of any size, and consequently the question of illumination called for a portable outfit which would provide adequate illumination and require minimum maintenance expense.

These conditions were admirably met by the adoption of acetylene flood lights. These handy lights, using cakes of processed carbide called Carbic, enabled the men to work comfortably under almost daylight conditions. The lights were easily moved about and cared for by unskilled labor, and withal, operated on a most economical basis.

The accompanying illustration shows the amount of illumination thrown by one light. At the time the photograph was taken a sand storm was raging yet the flame from this light stubbornly resisted this wind of almost gale force. A storm proof burner provides this feature.

This type of flood light is fool proof and safe, even under the most extreme conditions. If it is accidentally upset, the water in the generator simply runs out and gas generation stops immediately. This, and other features, cause it to be listed as standard by the Underwriter's Laboratories, Inc.

Cost per hour of service is low. The Carbic cakes are self feeding under a gas bell arrangement. When the light is shut off, generation of gas ceases, and the unused portion of the cake is saved for future use. Cakes may be left in the holder, or, being dry, solid and clean, can be slipped back into the original drum for future use.

BOOK REVIEW

OXY-ACETYLENE WELDER'S HANDBOOK, by M. S. Hendricks.

A working manual of instructions for oxy-acetylene welders which covers the fundamentals of oxy-acetylene welding in a clear and helpful manner. The important operating factors involved in welding are discussed principally from the standpoint of welding on steel, apparently because steel is the metal which is most commonly welded. However, the book is not lacking in complete information regarding the correct technique for welding other ordinary metals, such as cast iron, aluminum, copper, brass, bronze, nickel, monel metal and alloy steels. Much of the technique involved in welding these other metals has been developed during the past four or five years and is a considerable improvement over some methods which were considered standard in the early days of oxy-acetylene welding. There are also a number of special fields for welding, such as pipe welding, tank welding, aircraft welding, etc., for which much information of value is included in this handbook. A particularly interesting feature is the method of treatment of such subjects as the training of operators and the inspecting and testing of welds. These subjects are included to make the volume a useful guide to welding supervisors and instructors and at the same time present the facts regarding welding to the beginner in such a way as to encourage him to become his own supervisor and critic. The subject of the design of welds is discussed in detail and well illustrated. The conclusion of the chapter on testing welds is a discussion of all of the important factors involved in a complete welding operation, included as a guide to the welder or supervisor in setting up a standard of good practice or in checking up a welding operation to make sure that no detail of good procedure or organization of the work has been neglected. The table of contents includes: The Welding Gases; Welding Equipment; Setting Up Equipment; Methods of Welding; Preparation for Welding; Inspecting the Weld; Training Operators; Welding Properties of Common Metals; Testing; Important Applications: Published by the Acetylene Journal Publishing Company, 608 S. Dearborn St., Chicago, Illinois. 208 pages, 4¼" by 6½", 102 illustrations, flexible binding, price $3.00.

A METAL DEPOSITING TOOL

The Metals Coating Company of America, 497 N. Third St., Philadelphia, Pa., has recently distributed a two page folder describing the various uses to which their Metalayer tool can be put. This "putting on tool," as they describe it, simultaneously melts, atomizes and applies a coating of molten metal of any desired thickness. This is accomplished by means of a portable tool which is made up of the following elements: an oxy-acetylene melting flame, a compressed air turbo-motor which feeds a continuous wire rapidly into the flame, a compressed air jet which atomizes the molten metal, a three way valve which controls the burning gases, the motor, and the spray jet so that all act in unison.

The tool is held a few inches from the surface to be coated and is moved over it steadily. The molten spray is impacted on the surface in a dense coating without overheating the work. Wires of any commercial metal are used. Some of the common metals which are applied by this tool are: zinc, lead, copper, aluminum, iron, tin, bronze, brass, nickel, and monel. The gauge and rate of the feed and hence the rate of deposit, depend upon the melting temperature of the wire. For operating the tool compressed air is required at the rate of 50 cu. ft. per minute at a pressure of 50 lbs. per sq. in. When applying to metal surfaces they can be prepared by sand blasting. With proper control of the procedure a metal layer can be sprayed on non-metallic objects with this tool.

NEW BOOKLET ON ANACONDA WELDING RODS

The American Brass Company, Waterbury, Connecticut, have just issued a new twelve-page booklet describing the use of Tobin bronze and other copper alloy welding rods in the Anaconda line. The booklet shows a temperature color chart which illustrates the colors of steel by different temperatures up to the melting point and on the same page shows the melting points of the various Anaconda welding rods. There is an introductory discussion of the subject of bronze welding followed by instructions for the preparation of metals for bronze welding and the technique of applying the bronze filler rod. This is followed by a list with descriptions of the different copper alloy welding rods manufactured by the American Brass Company and a table showing the strength of these different materials and the weights of rods in different dimensions. There are a number of illustrations showing the different types of work which can be done with these rods and illustrating some of the important principles of correct methods of using them.

NEW GAS ENGINE DRIVEN ARC WELDING SET

The Westinghouse Electric and Manufacturing Company announces as new equipment a 300 ampere, gas engine driven, single operator arc welding set. Gas engine driven welding sets are used extensively for supplying welding current where a local power supply is not available as in the case of pipe line and storage tank construction, steam railroad construction and maintenance work, structural steel work, and general construction and repair jobs in isolated places.

New Westinghouse Gas Engine Driven Welder.

The complete set consists of a model P-35 Continental 4 cylinder gas engine direct connected to a new type Westinghouse 300 ampere, single operator, type SK, arc welding generator, with flexibly coupled exciter overhung from generator bracket. The generator has a special bracket which fits into the engine housing, so as to make the complete equipment as compact as possible. The generator control panel is mounted on top of the generator frame and fully enclosed by a sheet metal cabinet. The welding current is varied over the entire range by means of a single dial rheostat. Protective covers over generator commutator and engine hood make the complete equipment suitable for service in all weather conditions without the use of a canopy. The set can be made portable by the addition of running gear parts.

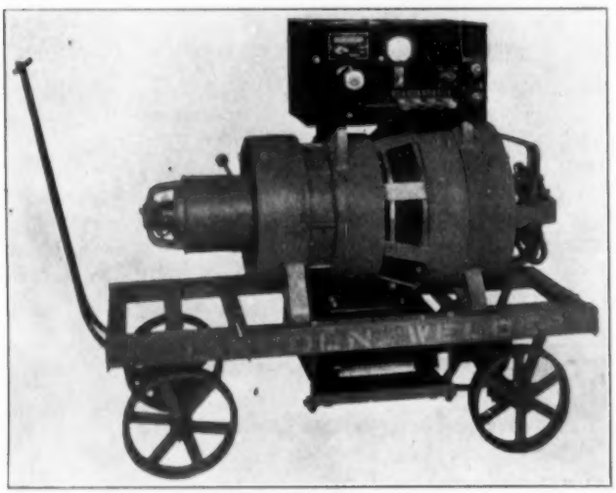
Another feature of this new set is that it is separately excited, resulting in simplifiel control and efficient operation, the exciter being flexibly coupled to the welding generator and overhung from the front of the generator bracket.

The Continental Red Seal engine has the S.A.E. rating of 28.9 hp. Under average operating conditions, the fuel consumption is approximately 1½ gallons per hour, the gasoline tank holding 28 gallons. For lubrication the pressure feed system with a gear type pump is used.

NEW LINCOLN "STABLE-ARC" WELDERS FEATURE UNIFIED CONTROL

New Lincoln "Stable-Arc" Welders, manufactured by The Lincoln Electric Company, Cleveland, Ohio, have recently been placed on the market. Many new features of design and construction increasing the stable arc features are introduced in the new improved type welders according to the manufacturers.

The unification of the controls of both motor and generator is one of the oustanding features. The working mechanisms of all controls are contained in a ventilated enclosed steel cabinet with hand regulators and switches mounted on a panel which forms a side of the cabinet. The control panel contains rheostat



The Latest Lincoln Model.

regulator, diverter switch, safety starter switch, volt-ammeter and wing nut terminals for cables. This unified control greatly increases the simplicity of the operation of the welder. The control cabinet is mounted directly over the motor generator for easy access by the welding operator. This also permits the removal of the motor generator armature, without disturbing any other parts.

The use of a combined voltmeter, and ammeter, known as a volt-ammeter, makes possible the reading of amount of voltage and amperage on one dial and eliminates the use of the separate delicate ammeter which would be given excessive wear due to the large output keeping the ameter jammed against the high limit pin on the dial. In this way, the volt-ammeter insures longer instrument life. The face of the volt-ammeter is mounted flush with the control panel assuring the utmost protection possible

Terminals for the lead cables are equipped with winged nuts, a feature which makes quick and easy connections possible, especially when it is desired to reverse the polarity of welding current. The use of these wing nut terminals also eliminates the necessity of a switch for reversing polarity.

The Lincoln Safety Push Button switch is incorporated in the control panel for starting and stopping of the welder. This new type switch, manufactured by The Lincoln Electric Company and introduced to the market only a short time ago, offers an added safety feature to the control mechanism of the new model welder. With this type of safety switch it is an impossibility to accidentally start the welder.

Enclosed wiring of all operating controls as well as a metal backed rheostat are the result of the use of a unified control cabinet. The mounting of this cabinet over the motor generator permits the use of a shorter chassis frame or base than used in previous models. The shorter base offers the advantage of less floor space occupied by the welder as well as a smaller turning radius of the portable models.

PURE IRON ERA FEATURES PROGESS OF WELDING

The current issue of the Pure Iron Era which is published by the American Rolling Mills Company, Middletown, Ohio, carries a feature article entitled "The Wonder World of Welding," by W. W. Petry. The author has so much information regarding the achievements of welding at his finger tips that he spends little time in introductory remarks, then plunges into the variety of applications of welding which have attracted wide-spread attention in the industrial world. Such subjects as welding in automobile construction, the welding of a battle ship, the welding of structural steel and the use of welded steel in the construction of machinery are presented with much interesting detail and in a manner which reflects a thorough understanding of the progress which welding has made in recent years. It is an unsually interesting article of this type and worthy of attention of anyone who is interested in the development of any phase of the art of welding.

ATOMIC HYDROGEN IN THE TALKING MOVIES

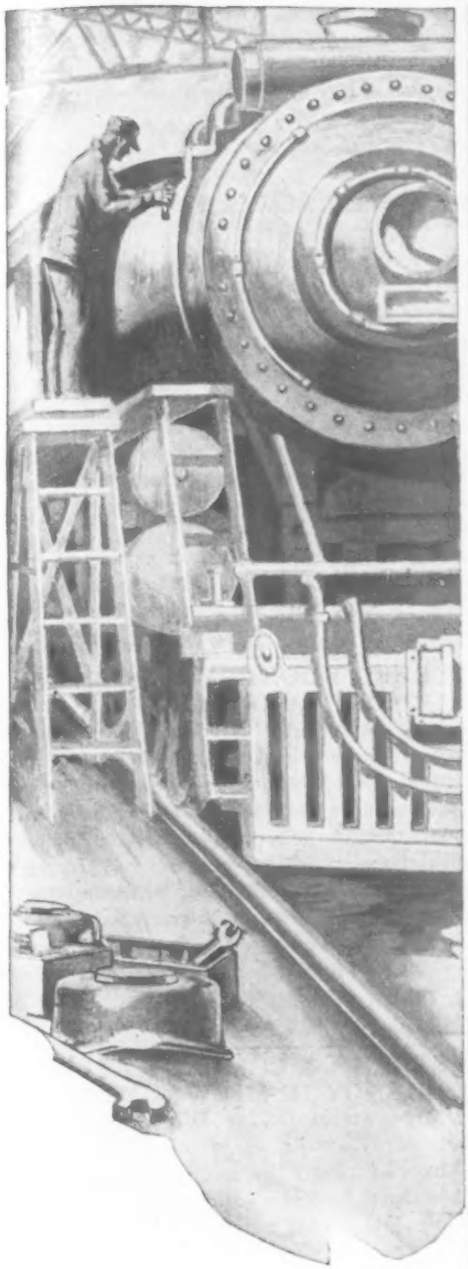
On June 27th, talking movies entitled "The Development of Atomic Hydrogen Welding," by Dr. I. W. Langmuir, of the General Electric Research Laboratory, Schenectady, N. Y., was the feature of the program of the noon day meeting of the Electric Club of Chicago. By means of a portable photophone, Dr. Langmuir explained how he discovered that atomic hydrogen makes extremely high temperature available for welding thin and nonferrous metals. This was the first talking motion picture program which the Electric Club of Chicago has had. It was very impressive to get the story of this interesting welding process from Dr. Langmuir himself in his own laboratory where so much of the development work was done, to hear him talk as he explained various features of the development and showed parts of the apparatus used, and hear the hiss of the atomic hydrogen flame while watching the picture of an actual demonstration.

HARRIS CALORIFIC CATALOG

The eleventh edition of the catalog of the Harris Calorific Company, Cleveland, Ohio, has just been published. The Harris Calorific Company as now constituted consists of a consolidation of the old Harris Calorific Company of Cleveland, Ohio, specialists in cutting equipment, and the United States Welding Company, formerly of Minneapolis, specialists in welding apparatus. The combined organization now offers a complete line of gas welding and cutting apparatus, acetylene generators, supplies, and etc. In the new catalog is listed the new Multi-Stage welding regulators which were recently put on the market. An attractive two-page folder in three colors has also been prepared which gives a complete description of this new regulator with illustrations in color showing both the exterior appearance and cut-away views in color showing the working parts and principle of operation.

NEW METAL CUTTING ALLOY

It is understood that a new tool of the tungsten-carbide type will shortly be placed on the market under the name "Haystellite." This alloy was introduced a short time ago for use as a diamond substitute on oil well bits and for drawing dies, and has been successful for these applications. A modification of the original alloy has been found to be valuable as a cutting metal, and laboratory and shop tests, the latter in a few of the largest production shops in the country, have been in progress for several months.



TOBIN BRONZE* WELDING

FOR HEAVY REPAIR WORK

TOBIN BRONZE Welding is considered the best and most economical method for making a wide variety of repairs in the shops of one of the largest midwestern railroads. For more than eight years the road has employed this method of welding because of its economy of time and labor.

The extent to which Tobin Bronze Welding is used for heavy repair work on locomotives, tenders and cranes may be judged from the following typical examples—Repairing web and frame cracks in rotating bases and deck castings of derricks; welding cracks in derrick hoist clutch drums; building up main rods on locomotives; welding stud flanges on front end of locomotive cylinder, repairing brake cylinder heads; welding cracks on super-heater heads; plugging enlarged keyholes on collar boxes; replacing broken metal on base castings for turrets; sealing cracks in pumps; welding cylinder blocks for gas motor cars.

Throughout the country, Tobin Bronze Welding is being used for similar heavy repair work because of its high strength and dependability and because of the saving in time and labor it affords. Full information upon request.

*Trade Mark Reg. U.S.,Pat. Off. and Canada.

THE AMERICAN BRASS COMPANY
GENERAL OFFICES: WATERBURY, CONNECTICUT
Offices and Agencies in Principal Cities
Canadian Mill: ANACONDA AMERICAN BRASS LTD.
New Toronto, Ont.

ANACONDA
WELDING RODS

ANACONDA
from mine to consumer

There is a suitable Anaconda Filler Rod for every welding purpose. The principal Anaconda Welding Rods, with their melting points, are listed below:

for oxy-acetylene welding

Tobin Bronze	1650°F
Manganese Bronze	1598°F
Brazing Metal	1634°F
Electrolytic Copper	1981°F
A. B. Naval	1625°F
Everdur	1866°F
Silicon Copper	1981°F

for arc welding

Phosphor Bronze	1922°F
Everdur	1866°F

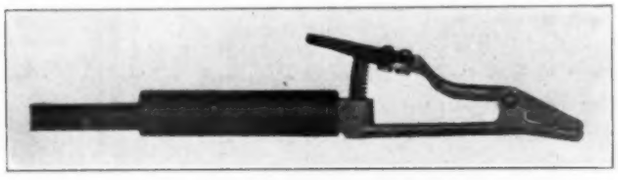
As its name indicates, Haystellite is made and sold by the Haynes Stellite Company, but it is not Stellite and differs radically from the latter in composition. The new product will have behind it the experience of a company that has specialized almost exclusively on metal cutting tools for many years.

The alloy, in so far as cutting tools are corned, is in the final development stage but the final tests and the manufacture of an initial stock of standard tools will be completed so that tools may be placed on the market some time during the latter part of this year. At the present time the manufacturer is not in a position to furnish sample tools, but expects to be able to do so in the near future.

GENERAL ELECTRIC ADDS ELECTRODE HOLDER TO LINE OF WELDING ACCESSORIES

As a supplement to its line of electric arc welding equipment, the General Electric Company announces a clamp type electrode holder. This device has jaws of heavy copper alloy, notched to hold firmly any size of electrode wire from 1/8 to 1/4-inch in diameter, in any position.

A molded compound handle protects the operator from heat



New G-E Electrode Holder.

and from contact with current-carrying parts. The holder is designed for use with currents up to 300 amperes. It may be obtained, if desired, assembled with five feet of extra flexible cable and terminal.

RYERSON CO. ANNOUNCES NEW APPOINTMENTS

The increase in the number of Plant and Departments and the growing diversity of products and markets has made it desirable to add to the executive staff, according to Edward L. Ryerson, Jr., president of Joseph T. Ryerson & Son, Inc.

The new elections and appointments are as follows:

Mr. A. M. Mueller, who has been associated with the firm for 30 years in the accounting and sales departments, becomes assistant secretary and member of the board of directors. Mr. Mueller was manager of the St. Louis Plant from 1914 to 1917 and later general manager of sales.

Mr. H. B. Ressler succeeds Mr. Mueller as general manager of sales. Mr. Ressler has a record of 25 years' experience as manager of the mill order department and manager of the St. Louis plant.

Mr. Robert G. Ross is advanced from General Traffic Manager to Assistant to the President in charge of Plant operation. This move will combine all operating and service with economy. Mr. Ross comes to his increased responsibilities with 26 years of experience in the operating, service and traffic departments. From 1923 to 1929 he was chairman of the Midwest Shippers Advisory Board, in which capacity he aided all shippers in securing better freight service and in adjusting differences between shipper and carrier.

Mr. Wm. H. Bryant, with 23 years of service with the Ryerson Company, becomes Chicago sales manager in charge of country and city store sales. He was formerly assistant manager of sales in charge of the Chicago country territory.

Mr. Guy H. Rumpf, formerly manager of plant operations, succeeds Mr. Ressler as manager of the St. Louis plant. He has been with the house for 17 years. Increased stocks in present lines and additional stock for new departments are being planned for this point.

Mr. Harry W. Treleaven, who has been with the firm for 20 years is elected assistant treasurer and will continue to be responsible for office management.

"These moves," says President Ryerson, "reinforce the executive personnel, keep pace with the growth and expansion of the business and make it possible to give even better service from an increasing number of plants and a fast widening range of products."

A NEW WELDING ENGINEERING SERVICE IN CHICAGO

Mr. Thomas D. Ketchbaw has recently announced the opening of an office at 3020 Broadway, Chicago, Illinois, for the purpose of establishing a personal welding engineering service for those who at any time may need it. Mr. Ketchbaw will act in the capacity of a consulting engineer in regard to any of the many problems which arise in the various phases of the welding processes. Problems of maintenance, production, analysis, research, physical property tests, or personal instruction in welding will be handled under this service.

The supervision of repair jobs in industrial plants is one of the major phases of this service, and several important jobs of this nature around Chicago have recently been handled by Mr. Ketchbaw.

HARRISBURG BOOKLET DESCRIBES THEIR PRODUCTS

The Harrisburg Pipe and Pipe Bending Company of Harrisburg, Pa., have recently issued a small booklet describing and giving data and specifications regarding their principal products. Several pages of the booklet are devoted to giving information about their forged seamless steel cylinders for transporting liquefied and high pressure gases. Other pages of the booklet describe the pipe coils and bends manufactured in their plant. These are used in refrigeration works, ice cream plants, hotels, packing houses, oil refiners, and paint plants. The booklet also mentions various forgings and other products which would be of interest to those connected with production welding.

THE N. A. STRAND & COMPANY APPOINTS AN AGENCY IN MILWAUKEE

The Western Iron Stores Co. of Milwaukee, Wisconsin, have been appointed Wisconsin agents of the N. A. Strand & Company. They will carry in stock a complete line of machines, flexible shafts, and the various attachments. They will thus be able to give prompt service to all the customers in that district.

NEWS OF THE WELDING TRADE

While attending the Convention of the Compressed Gas Manufacturers Association at Absecon, N. J., on June 6th, Mr. A. A. Heller of the International Oxygen Co., was hit by an automobile and dragged several feet. He suffered mostly from shock and was taken to the Atlantic City Hospital where he remained until June 12th. Mr. and Mrs. A. A. Heller had planned to sail on the Aquatania on June 19th for several months' stay abroad and we are pleased to report that Mr. Heller's condition was such as to permit his sailing as originally planned.

The Sales Engineering Company of Milwaukee has been merged with The Welding Engineering Company at 1030 38th Street. This concern handles a complete line of oxy-ecetylene and electrice welding equipment and supplies. Mr. A. H. Friese is president.

Notice has been received that the name of the C. H. Hollup Corporation has been changed to Hollup Corporation. The eastern division of this concern, formerly known as the Transportation Engineering Corporation, has changed its name to Hollup Corporation of New York.

AMERICAN STEEL ENGINEERING COMPANY
3520 Queen Lane, Philadelphia
601 Granite Bldg., Pittsburgh

Arc Welding Equipment
Sold and Rented
Complete Supplies Stocked
Write to nearest office for descriptive circular and prices

Taylor-Winfield Corporation of Warren, Ohio, announces the opening of a Detroit branch at 2857 E. Grand Boulevard, in connection with the offices of their representatives the Denton & Anderson Company. A stock of standard spot and butt welders and replacement parts will be available for prompt delivery. Mr. M. L. Eckman, formerly welding engineer in the Ford Motor plant, is retained by Denton & Anderson in the capacity of welding engineer.

Mr. J. M. Mathews of the Harris Calorific Company of Cleveland has just returned from a two weeks jaunt to the North Pacific Coast cities, Portland, Seattle, Vancouver, Spokane and the Canadian Northwest cities, Calgary, Saskatoon and Winnipeg. Arrangements were made with the Blue Tank Oxygen Company, just being organized in Seattle, under which that concern will handle Harris products in Oregon, Washington and British Columbia. Old time Harris connections, the Seattle Hardware Company of Seattle, and the Washington Machinery and Supply Company, Spokane, will continue to serve their trade with Harris products as in the past. Conditions in the Pacific Northwest are at least par, perhaps a little above.

Stoody Company, Whittier, California, manufacturers of Borium, Stoodite, Stoody Rod and equipment, announce the opening of a branch office in Tulsa, Oklahoma, located in the Exchange National Bank Building. D. F. McCandlish for a number of years branch manager for Purox Company in Kansas City is in charge of this new Stoody office and will direct the sale of Stoody products in the states of Missouri, Kansas, Oklahoma, Texas, Louisiana and Arkansas.

A new plant of The Linde Air Products Company, located at 2603 Floyd Street, Louisville, Ky., started on May 29 producing oxygen to supply the local demand.

Mr. Frye is superintendent of the new plant and W. L. Potts, whose headquarters are at the Cincinnati Linde plant, is district superintendent.

W. F. McKay, chief engineer for International Oxygen Company, Newark, N. J., has just returned on the Steamer Olympic after an extended combined business and pleasure tour of England, Scotland, France and Germany.

Leaflet 20421 entitled "Multiple Operator Arc Welding Equipment" is announced by the Westinghouse Electric and Manufacturing Company. This pamphlet presents the application, distinctive features and general principles of construction of different types of stationary and portable multiple operator arc welding sets. Several installation views are shown in the illustrations.

Classified Ads

Help Wanted—75c per line, minimum 4 line
Jobs Wanted—4 lines free.
Other Ads—$1.00 per line, minimum 4 lines.
Counted 8 words to line. Add 6 words for keyed address.

Business Opportunity—Engineer and welder of many years' practical experience as manager of modernly equipped and going Welding and Radiator Co., Inc., established 1914, in fast growing town of 20,000, in state of New Jersey, 30 miles from New York; seeks associate with similar experience and ability as executive and business promoter for expansion. Must have capital to acquire financial interest. State experience, age and references. Address Box 193, care of The Welding Engineer.

Salesman Wanted—Welding Equipment and Supply Salesmen for Chicago or Milwaukee territory. Good proposition. Write in confidence to A. H. Friese, care of Welding Engineering Co., 1032 38th St., Milwaukee.

Position Wanted—By thoroughly experienced job shop electric acetylene welder, available at once. Can furnish best of references. Address Box 190, care of The Welding Engineer.

Position Wanted—Experienced welder desires position as welder foreman on any kind of work. Have had years of experience in shop management and running construction jobs. Can weld any kind of metal. Have fair education, best of references, both as to character and ability. Address Box 191, care of The Welding Engineer.

Position Wanted—As welder in charge of maintenance in large plant. Have had seventeen years of gas welding experience on a wide variety of production and job shop work. Some arc experience, and want more. Address Box 192, care of The Welding Engineer.

Position Wanted—As welding instructor or salesman. Electric or oxy-acetylene. Ten years' practical experience in industry. N. Y. State Normal School teaching training. High school graduate. Age 32. Married. References furnished. Address Box 194, care of The Welding Engineer.

TISCO

MANGANESE STEEL WELDING WIRE $\frac{1}{8}$" to $\frac{5}{16}$" dia.
STOCK SHIPMENTS

The premier rod for the repair, or building up of worn Manganese Steel Track-work and other castings requiring a hard tough surface. Manufactured by the makers of Tisco Manganese Steel; the first in America to produce this remarkable metal.

WM. WHARTON JR. & CO. INC. EASTON, PA.
TAYLOR-WHARTON IRON & STEEL CO. HIGH BRIDGE, N. J.

Ordinary coke and limestone

will *not* make extraordinary carbide.

Hence National uses only

the purest ingredients it can get.

Write for illustrated story

NATIONAL CARBIDE

SALES CORPORATION, 342 MADISON AVENUE, NEW YORK

Where service is most severe
—*weld with* PAGE!

THE Burnham Manufacturing Company chose Page-Armco Welding Wire for welding these 48 and 60-inch outlets on pump lines at Utah Lake.

It is natural that Page Welding Wire and Electrodes should be chosen for exacting work. Every run is processed and flame-tested. In addition it is given an actual shop test to prove it will give results "on the job".

You will find Page Welding Wire will give you better work—save time—increase production—cut costs.

A sample for your own convincing test mailed on request.

PAGE STEEL *and* WIRE COMPANY
Bridgeport, Connecticut

District Offices:
Chicago New York Pittsburgh San Francisco

An Associate Company of the American Chain Company, Inc., Bridgeport, Conn.
Canadian Distributor and Manufacturer: Frost Steel and Wire Co., Limited, Hamilton, Ontario

PAGE-ARMCO
Flame-Tested PROCESSED Shop-Tested
Welding Wire *and* Electrodes

HOME OF BRONZEWELD RODS

Large stocks of Bronzeweld and other Welding Rods ready for immediate shipment are carried in our Chicago Warehouse, illustrated above.

You insure the quality of your welds—toughness, strength, uniformity, non-porosity—by using Bronzeweld. Bronzeweld fuses quickly, melts at a low temperature and flows evenly and smoothly. Laboratory controlled to insure superior quality. For welding Bronze or Brass and brazing Malleable Iron or Steel parts.

A Rod for Every Job in Gas and Electric Welding

Our principal kinds of Welding Rods are:

WILSON COLORTIPT	CASTWELD	HIGH MANGANESE	ELECWELD Nos. 10 and 18
NORWELD SPECIAL	BRONZEWELD	NICKELWELD	STEELWELD
NORWELD	HICARWELD	ELECWELD SPECIAL No. 6	VANADWELD

Send for the Welder's Guide, a Practical Book on Welding

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STEEL—MONEL METAL—NICKEL—BRASS—COPPER—COPPERWELD—NICKEL SILVER—NICKELOID—PHOSPHOR BRONZE—ALUMINUM

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Never in the history of the oxy-acetylene industry has there been offered such a variety of equipment as the Torchweld line—because—

Torchweld line has the right torch and regulator for your work. Each style is correctly designed and constructed—mechanically perfect in all respects—and carries a reputation for superior performance.

Our new catalog contains information about oxy-acetylene apparatus which you will find very useful, and is full of buying helps which make the selection of equipment an easy matter.

Send For

The New

Catalog No. 29

Your Copy Is Ready

TORCHWELD EQUIPMENT COMPANY
224 N. Carpenter St. CHICAGO

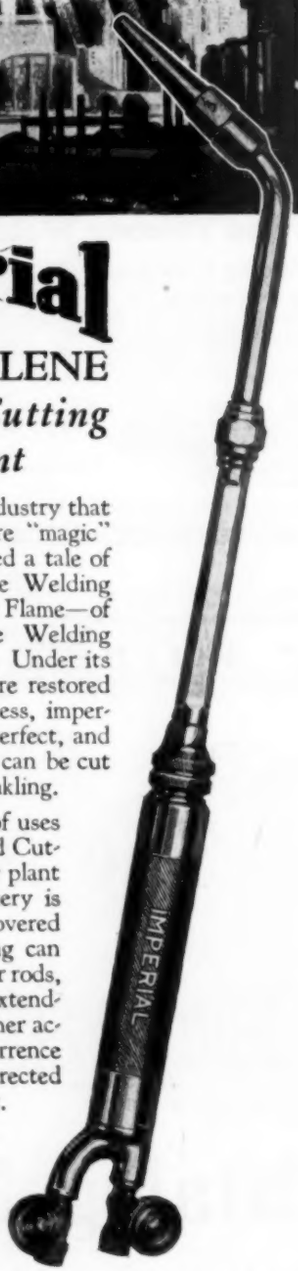
Imperial

OXY-ACETYLENE
Welding and Cutting Equipment

THERE is a flame in industry that is capable of far more "magic" than any that ever graced a tale of old Bagdad. This is the Welding Flame—and the Cutting Flame—of Imperial Oxy-Acetylene Welding and Cutting Equipment. Under its influence broken parts are restored to their original usefulness, imperfect castings are made perfect, and six inches of solid steel can be cut through almost in a twinkling.

There are hundreds of uses for Imperial Welding and Cutting Equipment in every plant where metal or machinery is used. Blowholes discovered after or during machining can be quickly filled. Shafts or rods, made too short, may be extended. And hundreds of other accidents of frequent occurrence may be economically corrected with Imperial Equipment.

Imperial Oxy-Acetylene Welding is daily finding new uses in production operations where it increases output and cuts costs. Let our engineers suggest the correct type of Imperial Equipment for you.



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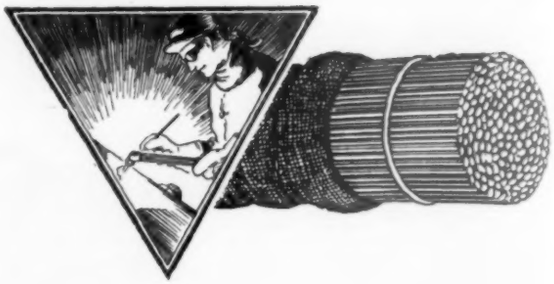
THE IMPERIAL BRASS MFG. CO.
522 South Racine Ave., Chicago



Ten Grades

What's your welding job?

Based upon extensive research and experience, Wickwire Spencer welding engineers have developed ten grades of Wissco Welding Rods for either electric arc welding, gas welding or carbon arc welding.

The use of the right grade of Wissco Welding Rods for your particular welding job results in stronger welds at lower cost through a saving of the welder's time and lower gas or electricity consumption.

The quality of every Wissco welding rod is PRE-TESTED and uniformly maintained in every length. Wissco welding engineers will be glad to consult with you on the particular grade for the most advantageous use on your type of welding. Simply state your welding problem.

WICKWIRE SPENCER STEEL COMPANY
41 East 42nd St.
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Los Angeles Worcester Cleveland

WISSCO *WELDING RODS*

Uniform Quality Assured

WELDERS who use Commercial Acetylene soon learn that every cylinder contains the same pure gas.

Your torch can tell the difference!

COMMERCIAL ACETYLENE
Means pure acetylene.

COMMERCIAL SERVICE
Means prompt service.

No matter what your gas requirements may be you will be interested in our sales plan. Ask our nearest office to tell you about it.

Supplied in the following size cylinders:

10x30-in. size	- -	125 cu. ft. cap.
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Commercial Acetylene Supply Company, Inc.

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BRANCHES:

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HANDY & HARMAN
HANDY SOLDERS QUALITY SERVICE

Silver Brazing is frequently *the Cheapest*

method of joining metals—all costs counted—when you use

Handy Silver Solder

1. **Less Time** is required, because "Handy" Silver Solder **flows more** freely than spelter, brass or bronze welding materials.
2. **Less Solder** is required, because a thin film of "Handy" Solder does the work.
3. **Less Finishing** is required, because "Handy" Solder makes neat, compact joints.
4. **Less "Rejects"** are certain, because joints soldered, brazed or welded with "Handy" Silver Solder are so much neater, stronger, tighter than the old way, that customers are delighted.

Works With All Metals having a Fusing point 1400° F. or higher—Iron, Steel, Copper, Brass, Bronze, Extruded Metals, Stainless Steel, Monel Metal, etc.

Furnished in wire, rods, strips, sheets or "filings"—in 12 distinct guaranteed compositions ranging from 80% silver, down to about 10%—and in melting points from 1325° F. up to 1600° F., depending on the Silver-content.

Send for the "Handy" Book of Silver Solder

Full of practical information on soldering, brazing and welding.

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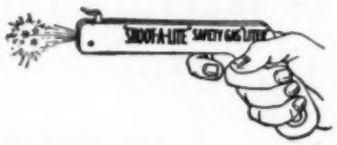
THE PRACTICAL TORCH LIGHTER



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SAFETY
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Order from your jobber

Arc Welding Handbook

BY C. J. HOLSLAG

A simple and practical manual of instruction in arc welding. The beginner is led step by step to complete mastery of the process. The supervisor is furnished a reliable guide for the training of new operators. The experienced operator is posted on principles which were overlooked in his first teaching.

250 Pages
Well Illustrated

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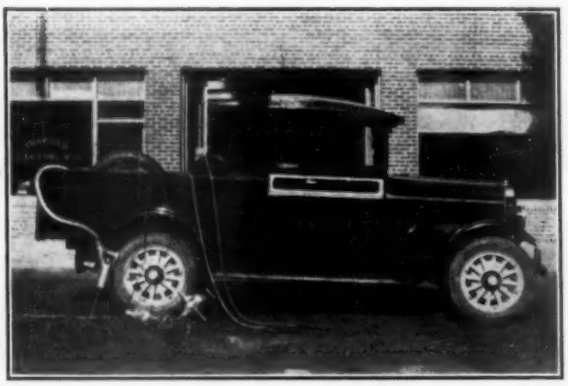
PORTABLE ARC WELDER



A MACHINE of the highest quality, backed by years of experience and service, designed and built for dependable, efficient and economical operation.

This portable machine combines the portability of the ordinary car and the welding facilities of the largest stationary machine.

The smooth arc is easily controlled and of great penetration producing a weld that is strong and ductile.

The ease and efficiency of operation of this machine will increase production and reduce costs.

Detailed information forwarded on request

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Membership In The American Welding Society Is Testimony Of Your Interest In Welding.

Send Your Request For Application Blank To

American Welding Society

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K-G

CUTTING TORCHES SAVE GAS

SOMETIMES K-G cutting torches seem to use less oxygen than other makes, when as a matter of fact the saving is largely accounted for by the fact that K-G Torches do not leak.

The commonest source of trouble with most cutting torches is leakage around the excess oxygen trigger valve. The trigger valve in the K-G is purposely made simple and accurate to prevent this costly leakage loss.

K-G Welding & Cutting Co.
515 W. 29th St. New York City
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K-G
Style "M"
Cutting Torch

Supplied with four interchangeable tips. Tips come in eight standard sizes, 1 to 4 having either three or five preheating holes, as desired, and 5 to 8 having 5 preheating holes. Tips for use with any cutting gas carried in stock. Special tips can be furnished for every cutting requirement.

Length of standard torch, 20 inches; weight, 2 lbs., 9 oz. Torch can be made any length desired.

The following K-G dealers are ready to take care of your apparatus requirements promptly:

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HARRY P. WINSLOW, 35 Vinton St., Worcester, Mass.
WISCONSIN MOTOR PARTS CO., 2354 Cottage Grove Ave., Chicago, Ill.
PASSAIC-BERGEN WELDING WORKS, 650 Main Ave., Clifton, N. J.
SUTTON-GARTEN CO., 217 W. 10th St., Indianapolis, Ind.
E. BRASS AUTO SUPPLY CO., INC., 307 Burnet St., New Brunswick, N. J.
WELDING & SUPPLIES CO., 3445 Parthenais St., Montreal, Canada
CHICAGO GRINDING & MACHINE CO., 2117 Tilden St., Chicago, Ill.
SIGHT FEED GENERATOR CO., W. Alexandria, Ohio
CENTRAL OHIO WELDING CO., 783 No. 4th St., Columbus, Ohio
FRANK MILLNER COMPANY, 102 N. Olden Ave., Trenton, N. J.
SPRAGUE SERVICE & SUPPLY CO., 276 Davidson Ave., Perth Amboy, N. J.
STORTS WELDING COMPANY, 44 S. Colony St., Meriden, Conn.
WILLIAM McCARTHY, 308 James St., Syracuse, N. Y.
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The Solution of Your Problems In The Repair of
Scored Cylinders, Water Jackets, Radiators

The great need for a Flux which will absolutely Tin Cast Iron has, after years of experiment by the Kansas City Oxygen Gas Co. been supplied in Rep Flux.

Rep Flux will tin any metal but Aluminum — pre-heating unnecessary—only a small flame is needed.

Rep Flux will tin scored cylinders without removing block from chassis. Scores are then filled by applying Rep Rods by small welding flame.

Large returns for small investment.

Complete catalog Welding and Cutting equipment and supplies furnished on request.

Kansas City Oxygen Gas Co.
Pioneer Gas Manufacturers of the West
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Big Jim (Master Welder) says:

One of the many reasons why FRE-FLO rods are used by the best welders in the trade is because they comply with the requirements of the American Welding Society, the U. S. Government and with railroad specifications.

They'll save you money and make the best welds for you too—try 'em out.

[Ask for a free sample of FRE-FLO to try in your shop.]

Big Jim (MASTER WELDER)

FRE-FLO Rods are sold only through distributors. A few desirable territories are still open. Correspondence from distributors is invited.

The Atlas Foundry Company
Dept. "B"
W. 69th & W. & L. E. Ry. Cleveland O.

30% More Welding From Each Tank of Gas, with a

WELDIT GASAVER

GAS consumption stops instantly when torch is placed on hook. Passing the torch tip over pilot light gives same flame adjustment instantly.

No time or gas is lost adjusting flame.

Safety check valve prevents injury to apparatus in case of flashback.

Can be used with all makes of portable and stationary outfits.

Approved by
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Welding Torches	Cast Iron Rods
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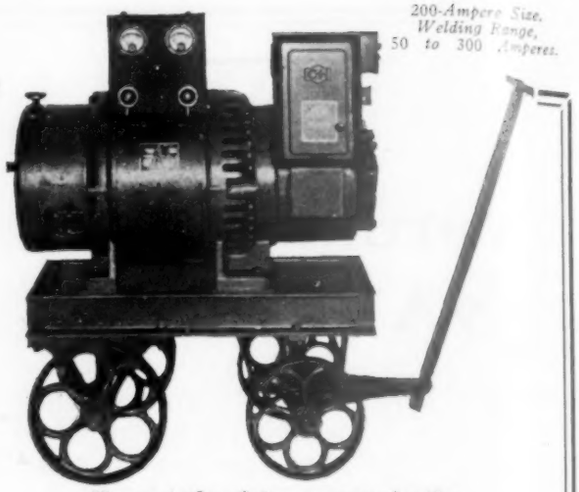
WELDIT ACETYLENE CO.

634 Bagley Ave. **DETROIT, MICH.**

200-Ampere Size. Welding Range, 50 to 300 Amperes.



Here are the plain reasons why the

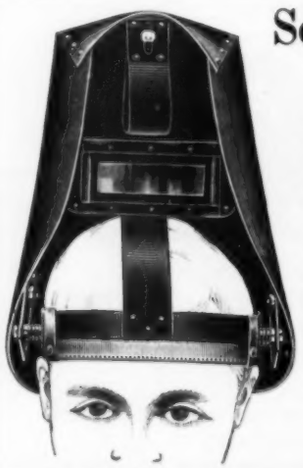
Hansen Arc Welder

will do things no other welder will do

1. No external stabilizer (an exclusive Hansen feature).
2. Extreme simplicity (self-excited; only one adjustment).
3. Remarkable stability of the arc.
4. Wide welding range (70 to 400 amps. on 300 amp. size).
5. High overall efficiency.
6. Unusual ease of operation.

Study these advantages, and you'll see why the HANSEN ***does*** deliver a better welding job.

NORTHWESTERN MFG. CO.
Clinton and Madison Sts., Milwaukee, Wis.



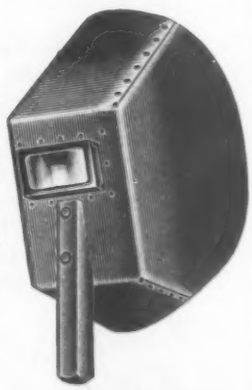
Sellstrom *Super-Service* Helmet and Handshield

Nos. 202, 203, and 172

Until you have used a Sellstrom Super Service Helmet you don't know the comfort of wearing a helmet. A head shield helmet that is as nearly perfect as is possible to make anything. 100% increased wearing efficiency. 50% less lens replacement cost, and comfort beyond your ability to imagine, is what you get when you buy Sellstrom super-service helmets.

Efficient convenience of manipulation and full protection for the eyes are built into these light-weight fibre helmets. Sellstrom super-service helmets are designed to give security to the eye, to fit the head as comfortably as an old hat, and to eliminate as far as possible the breakage of expensive lenses. No welder will part with a super-service helmet when once he has worn one.

Sellstrom specially designed lens holder enables wearer to change lens or cover glass with minimum effort. All hazard of breaking costly welding lens when changing cover glass is completely eliminated in the Sellstrom Helmets. You simply press down on the spring catch and lift lens out with hand. Only a few seconds required.



When in the market for welding goggles, lens, helmets or handshields, write

SELLSTROM MFG. CO., 344 N. Ogden Ave., Chicago

Grinding Drop Forging Die with Haskins Equipment

Revolutionizing Tool Equipment

One by one, industry is discarding its antiques and becoming modern in its methods of manufacture, handling, and assembly. Youth is winning in the competition with old age, and "elderly equipment" is being eliminated.

Laborious, time-wasteful carrying of work to the tool cannot hope to survive. It's easier, quicker, and cheaper to bring the tool to the work.

HASKINS Flexible Shaft Tool Equipment is opening industry's eyes to the great possibilities of this modern method. Adaptable to almost every manufacturing and assembly process, this "powered hand-tool" is solving new problems every day and establishing its superiority even in its own field of endeavor.

Whatever the character and quantity of your tool operations, HASKINS invites your interest and consideration. A type of equipment especially suited to your requirements is unquestionably embodied in the large line of HASKINS models.

Tell us your problems. Write for catalog describing the HASKINS Line.

R.G. HASKINS COMPANY

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Branch Offices in Principal Cities

Look at it any way you like —

SHAWINIGAN CARBIDE

gives "More Gas per Pound"—

SHAWINIGAN PRODUCTS CORPORATION · NEW YORK · *Plants: Shawinigan Falls, Quebec · · Keokuk, Iowa · · Anniston, Ala.*

Standard size pound box, $4.50.

Crown All-Metal Filler is a mineral composition that repairs cracked waterjackets, motorheads, waterpumps, porous castings, etc., by simply heating the casting to 400° heat and rubbing on the Crown All-Metal Filler, which will penetrate through to the underside and rust up and make a guaranteed, permanent repair. Can be made to flow up, down or sideways. Being gray in color, it blends with cast iron and steel, although it can be used on all metals.

SPECIAL FOR ELECTRIC WELDERS

Crown All-Metal Filler is the only compound that will make an electric weld on cast iron absolutely watertight. It penetrates through the smallest pin-hole where it is possible for water to leak out, and the filler will rust, which is necessary for a permanent repair.

Oldest Exclusive Makers of Aluminum Solders

TRADE MARK

CROWN CROWN CROWN

Crown Aluminum Solder (hard) has been tested by the Bureau of Standards, Washington, D. C., and shown to possess tensile strength of 14,500 pounds to the square inch. Not only is Crown the strongest made, but the easiest to handle and apply, and the saving of labor makes Crown a necessity to every welder.

Crown Aluminum Solder (soft) is recommended for sheet aluminum, particularly on body work and can be applied with ordinary soldering iron. After the solder is properly applied it can't be separated from the aluminum with aid of chisel and hammer. The soft is also recommended for cracks in castings.

Crown Iron Metallic Filler is the incomparable metal for filling scored cylinders. The special Crown acid is supplied free.

WRITE TODAY FOR NEW AND LARGER DISCOUNTS ON ALL CROWN SOLDERS

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WELDING WIRE

Produces Tough, Sound Welds with a minimum of labor, time and expense.
Uniformly good results have been secured by its use throughout the past fifteen years.
All Grades — Gas and Electric — Immediate Delivery

IGOE BROTHERS, Manufacturers
240 POINIER STREET, NEWARK, N. J.

Ryerson Welding Equipment

Wilson Arc Welders Model S 200 Amp. Portable Type

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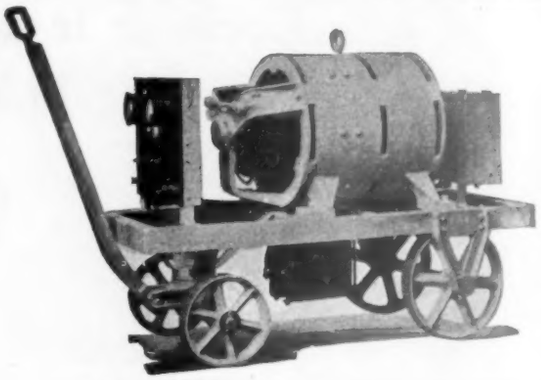

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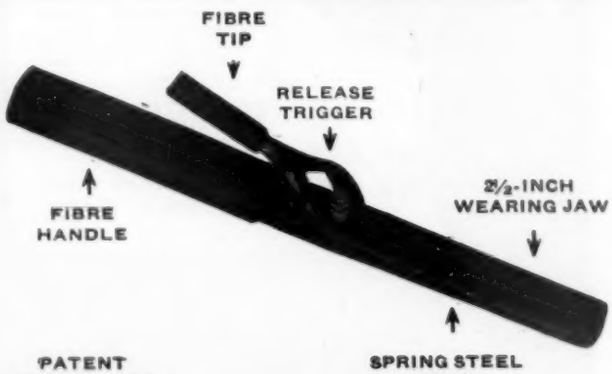

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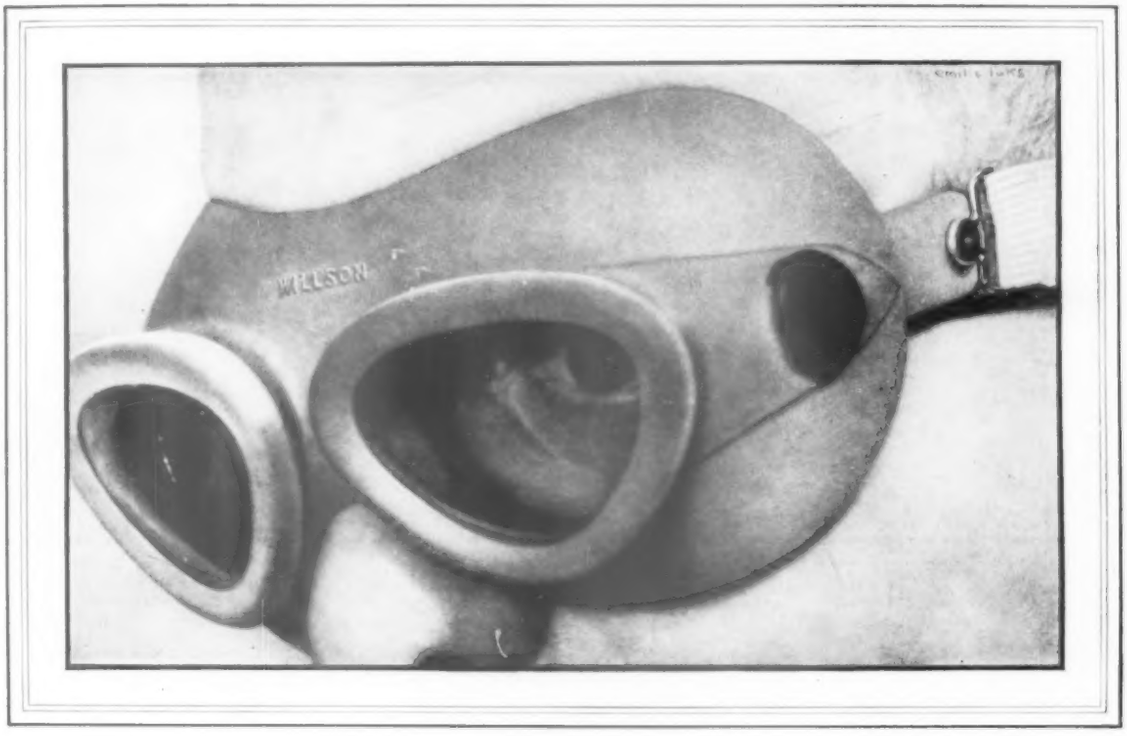

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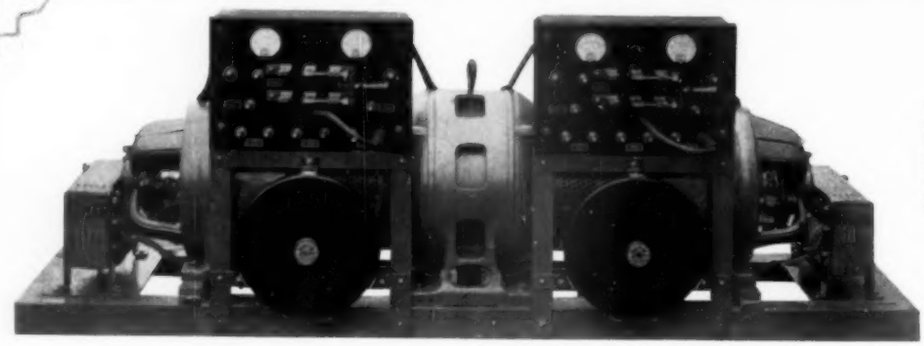

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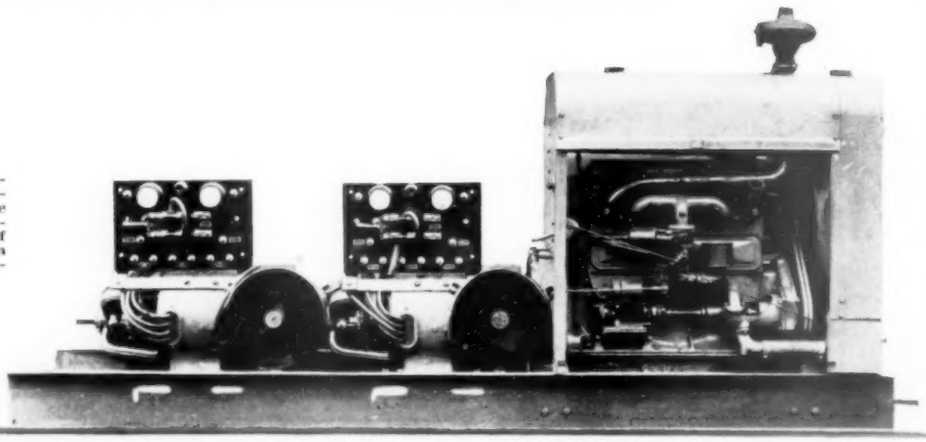

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